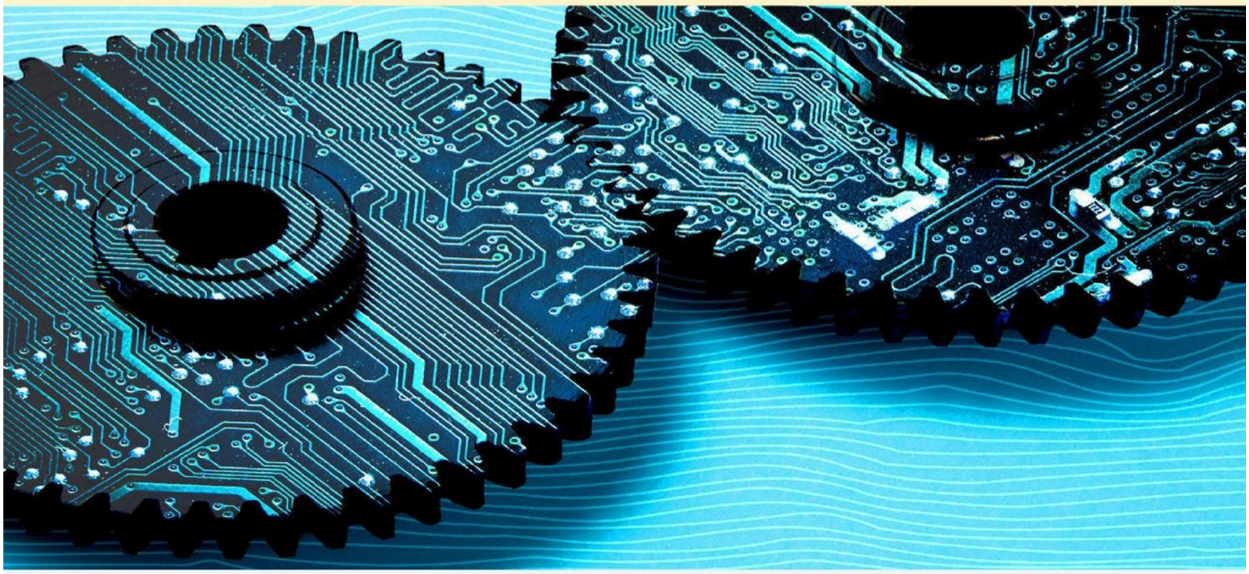
IIMT UNIVERSITY MEERUT
Transforming Education System, Transforming Lives
UGC Approved Section 2(f) & 12B
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SCHOOL OF ENGINEERING & TECHNOLOGY

ACADEMIC HAND BOOK



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ORDINANCE & ACADEMIC REGULATIONS
ENGINEERING PROGRAMS (UG/PG/PH.D.)
(ACADEMIC SESSION 2025-26)

IIMT UNIVERSITY MEERUT
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1. Preamble

As per the recommendations of UGC/Higher Education Institutions in India/UP Higher Education department, the IIMT-University has introduced Choice Based Credit System (CBCS) and implementation of NEP-2020. Choice Based Credit System (CBCS) is a proven, flexible mode of learning in higher education which facilitates a student to have guided freedom in selecting his/her own choices of courses in the curriculum for completing a degree program.

CBCS offers a flexible system of learning.

The system permits a student to

a. Learn at their own pace through a flexible registration process.
b. Choose electives from a wide range of courses offered by parent and other departments.
c. Undergo additional courses to acquire the required number of credits for obtaining B.Tech. Engineering.
d. Undergo additional courses in their special areas of interest and earn additional credits to obtain B.Tech. Engineering.
e. Adopt an interdisciplinary approach in learning.
f. Avail transfer of Credits.
g. Gain Non – CGPA credits to enhance skill/employability by taking up project work, entrepreneurship, co-curricular and vocational training.
h. Make the best use of the expertise of available faculty.
i. Learn and earn credits through MOOC, and Project Based Learning.
j. Enhance their Knowledge, Skill and Attitude through participation in innovative Curriculum Design, Delivery and Assessments.

The Curriculum is designed to take into the factors listed in the Choice Based Credit System (CBCS) with focus on Project Based Learning and Industrial Training to enable the students to become eligible and fully equipped for employment in industries choose higher studies or entrepreneurship.

Vice – Chancellor

2. Definitions & Nomenclature

In these Regulations, unless the context otherwise requires:

a. "Program" means Degree/Diploma Program like Computer Science / AIML / Civil / Electrical & Electronics Engineering / Mechanical / Aerospace / Electronics & Communications / Electrical Engineering branches.
b. "Course" means a theory or practical subject that is normally studied in a semester.
c. "Vice–Chancellor of IIMT-University" means the Head of the University.
d. "Registrar" is the Head of all academic and General Administration of the University.
e. "Dean" means the authority of the school that is responsible for all academic activities of various programs and implementation of relevant rules of these Regulations pertaining to the Academic Programs.
f. "Controller of Examinations" means the authority of the University who is responsible for all activities related to the University Examinations, publication of results, a ward of grade sheets and degrees.
g. "Dean – Student Welfare" is responsible for all student related activities including student discipline, extra and co–curricular activities, attendance and meetings with class representatives, Student Council, and parent–teacher meet.
h. "HOD" means the Head of the Department concerned.

i. "University" means IIMT-University, Meerut.
j. "TCH" means Total Contact Hours–refers to the teaching–learning periods.
k. "DEC" means Department Exam Committee.
l. "BOS" means Board of Studies.
m. "ACM" means Academic Council meeting the highest authoritative body for approval for all Academic Policies.
n. "Class Coordinator" is a faculty of the class who takes care of the attendance, academic performance, and the general conduct of the students of that class.
o. "IA" is Internal Assessment which is assessed for every student for every course during the semester.
p. "EA" for External Assessment: This assessment will be carried out at the end of the Semester as per the Academic Schedule.
q. "ESE" is End Semester Examination conducted by the University at the End of the Semester for all the courses of that semester.
r. "UGC" means University Grants Commission.
s. "MHRD" means Ministry of Human Resource Development, Govt. of India.
t. "AICTE" means All India Council of Technical Education. 20. "HEI" means Higher Education Institutions.
u. "AE" is Aerospace Engineering, "CSE" is Computer Science &Engineering, "CE" is Civil Engineering, "EE" Electrical Engineering, "ME" Mechanical Engineering, "TE" is Transportation Engineering, "CTM" is Construction Technology & Management, "SE" is Structure Engineering, "PED" is Power Electronics & Drive, "ECE" is Electronics & Communication Engineering,

3. Vision and Mission of the School

3.1 VISION

The quality of education must come first to nurture the students of engineering to fit into the global market. As competent professionals is the forefront to compete with latest development engineering by implementing embedded systems with diversified technology.

3.1 MISSION

Apply solutions to real problems, build a skillful team and encourage sustainable & remarkable learning with advanced knowledge of community &ethical commitments. By conducting high quality education and learning to achieve the next step of expertise in trendy software platforms to meet the dynamic needs of innovations and research.

4. Program Outcomes (Common for B.Tech / M.Tech Program)

PO1 - Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 - Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 - Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 - Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 - Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 - The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 - Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 - Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 - Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 -Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 -Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 -Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

5. Program Educational Objectives

PEO1- To impart a program oriented knowledge in mathematical, scientific and engineering fundamentals required to solve electrical engineering problems.

PEO2- To make the students able to adopt lifelong learning, act with integrity and have inter-personal skills needed to engage in, lead and nurture diverse teams with commitment to their ethical and social responsibilities

PEO3- To provide students towards a broad understanding of engineering & management principles and apply this knowledge for solving complex and multidisciplinary engineering problems

PEO4- To impart graduates with ethical values so that they can become responsible engineers.

PEO5- To prepare graduates who will be employable in the diversified sections of industry, government organizations, public sector and multinational corporations and/or pursue higher education in electrical engineering or other fields of their interests.

6. Program Specific Objectives

6.1 PSO's for B.Tech Computer Science Engineering/ CSE-AIML

PSO1- Enabling students to learn continuously and to provide effective answers to new computational issues.

PSO2- Understand analyze data and create software to create computer-based systems of varying complexity that are designed effectively.

6.2 PSO's for B.Tech Electrical Engineering

PSO1- Apply the fundamentals of mathematics, science and engineering knowledge to identify, formulate, design and investigate complex engineering problems of electric circuits, analog and digital electronics circuits, control systems, electrical machines and Power system.

PSO2- Apply the appropriate techniques and modern engineering hardware and software tools in electrical engineering to engage in life-long learning and to successfully adapt in multi-disciplinary environments.

PSO3- Aware of the impact of professional engineering solutions in societal, environmental context, professional ethics and be able to communicate effectively.

6.3 PSO's for B.Tech Mechanical Engineering

PSO1- Ability to recognize and examine the mechanical parts, machine apparatuses and systems and to get to know platforms, apparatuses, innovative work in the area of Mechanical Engineering.

PSO2- Apply the concepts of Mechanical Engineering and use AUTO CAD, Solid Works and Ansys software for the design and development of industrial problems.

PSO3- Apply the knowledge of Mechanical Engineering in the various fields such as automobile industries, manufacturing units and power plants etc.

PSO4- Apply the principles and knowledge of Mechanical Engineering to analyze the most advanced system.

6.4 PSO's for B.Tech Civil Engineering

PSO1- To develop the professional skills in the area of construction & management and structural engineering.

PSO2- Analyze and design the various structural components by using codal provisions.

PSO3- Analytical and ethical design skills among students to make the capable to started career as a good engineer.

PSO4- To enhance the sustainable development in the word with their skills.

6.5 PSO's for B.Tech Aerospace Engineering

PSO1- After completing the course, the graduate will have strong basics in aeronautical sciences which will help him/her to pursue either higher studies or seek employment in aeronautical / astronautical or allied fields. The strong foundation knowledge will help the graduate to become a brilliant academician, a successful engineer/scientist or even an entrepreneur.

PSO2- The graduate will have the ability to help society by way of his participation in delivering useful products and services to society through his/her work in industry, research organization, educational institution, business organization etc. as he/she has strong basic knowledge in aeronautical / astronautical engineering & ethics and is environmentally conscious.

PSO3- The curriculum and syllabus have been framed in such a way to impart desire to the graduate to acquire knowledge, on continuous basis even after completing the program. This would help the graduate to excel in the line of profession he/she has chosen.

PSO4- Graduate will be able to work as a team member which will be a main requirement in industry or research organization or in any business enterprise. This will pave the way for successful career for the graduate and play a role for the success of the organization in which the graduate is employed.

7. ADMISSION

a. The admission policy and procedure shall be decided from time to time by the

Academic Council of the University based on the guidelines issued by the UGC/NEP/AICTE and Ministry of Education (MoE), Government of India. Seats are also made for Non-Resident Indians and foreign nationals, who satisfy the admission eligibility norms of the University. The number of seats in each of the b. Tech. degree program will be decided by the University as per the directives of AICTE / UGC / MOE, Government of India, considering the market demands.

b. The University can take 10% additional admission, in view of the short fall expected in 2nd year due to failure of students or students leaving the University.

8. Eligibility for Admission

8.1 Eligibility for Admission to UG Program in Engineering (CSE/CE/EE/ME/AE)

Table No: 1.1

1	B.Tech in (CSE/CE/EE/ME/AE)#	4years	Passed 10+2 examination with Physics / Mathematics /Chemistry/ Computer Science / Electronics / Information Technology/Biology/Informatics Practices/ Biotechnology /Technical Vocational subject/Agriculture/Engineering Graphics / Business Studies / Entrepreneurship as pertable 1.2 & 1.3 Agriculture stream (for Agriculture Engineering) Obtained at least 45% marks (40% marks in case of candidates belonging to reserved category) in the above subjects taken together. OR Passed min. 3 years Diploma examination with at least 45%marks (40% marks in case of candidates belonging to reserved category) subject to vacancies in the First Year, in case the vacancies at lateral entry are exhausted. (The Universities will offer suitable bridge courses such as Mathematics, Physics, Engineering drawing, etc., for the students coming from diverse backgrounds to prepare Level playing field and desired learning outcomes of the program)
2	B.Tech in (CSE/CE/EE/ME/AE) (Lateral Entry to Second year)#	3 years	Passed Minimum THREE years / TWO years (Lateral Entry) Diploma examination with at least 45% marks (40% marks in case of candidates belonging to reserved category) in ANY branch of Engineering and Technology. OR Passed B.Sc. Degree from a recognized University as defined by UGC, with at least 45% marks (40% marks in case of candidates belonging to reserved category) and passed 10+2 examination with Mathematics as a subject. OR Passed D.Voc. Stream in the same or allied sector. (The Universities will offer suitable bridge courses such as Mathematics, Physics, Engineering drawing, etc., for the students coming from diverse backgrounds to achieve desired learning outcomes of the program).

3	B.Tech in (CSE/CE/EE/ME/AE)(Lateral Entry to Third year)#	2 years	Refer Table No: 1.2 & 1.3
4	B.Tech in (CSE/CE/EE/ME/AE) (Lateral Entry to Final year)#	1 year	Refer Table No: 1.2 & 1.3
#Respective State Government/ Affiliating University/Board may decide the eligibility criteria for entry level Qualification for different Program/Courses.			

Table No:1.2

Undergraduate Program offered By SET	Optional Subjects in class 10+2 (12th) or equivalent
Aerospace Engineering	Physics or and Maths
Electrical Engineering	Physics and Maths
Civil Engineering	Physics, Chemistry and Maths
Computer Science Engineering	Physics and Maths
Computer Science Engineering (AIML)	Physics and Maths
Mechanical Engineering	Physics, Chemistry and Maths
OPTIONALSUBJECTS	(1) Chemistry (2) Biology (3) Biotechnology (4) Technical Vocational subject (5) Computer Science (6) Information Technology (7) Informatics Practices (8) Agriculture (9) Engineering Graphics (10) Business Studies (11) Electronics (12) Entrepreneurship

Table no:1.3

S. No.	Academic Level	Entry Qualifications at different levels	Exiting Qualifications at different levels	NHEQF/ NSQF level	Unified Credit Level (UCF)
1	1st year UG Degree	12th Completed	Under graduate Certificate	Level 5	4.5
2	2nd year UG Degree	A candidate with Diploma inappropriate branch of Engineering / Equivalent Vocational or Technical Program with NHEQF level5 / UCF level4.5completed	Under graduate Diploma	Level 6	5.0
3	3rd year UG Degree	A candidate with 10+4/ 12+2 in appropriate domain with NSQF level 6/UCF level	Bachelor of Vocational Education	Level 7	5.5

		5completed			
4	Final year UG Degree	A candidate with 3 years bachelor's degree in vocational /B.Sc. in appropriate domain with NHEQF level 7 / UCF level 5.5 completed	B.E. / B.Tech.	UG Engineering Degree	6.0

8.2 Eligibility for Admission to PG Program in Engineering (Master of Technology in CTM, Environment Engineering, SE, TE, EE, PED, ECE, CSE)

Table No:1.4

1	M.Tech in CTM, Environment Engineering, SE, TE, EE, PED, ECE, CSE)	2 years	B.Tech with 55% marks (relevant stream)

8.3 Eligibility for Admission to Diploma Program in Engineering (CE, EE, ME, CSE)

Table No: 1.5

1	Diploma in (CE, EE, ME, CSE)	3 years	10^{th} Passed
2	Diploma in (CE, EE, ME, CSE) Lateral Entry	2 years	10+2 / ITI Diploma, PCM with 35% marks

9. Curriculum

For the purpose of awarding degrees the curriculum of all M.Tech / B.TECH Engineering programs is structured to have a minimum of credits+ NCC (Non-credit Audit Courses) as specified in the evaluation scheme approved by the university's Board of Studies and spread out across four / eight semesters of study of each program respectively.

Under CBCS, the degree program will consist of the following categories of courses:

1. Basic Science Course-BSC
2. Human Science Course-HSC
3. Skill Enchantment Course–SEC
4. Generic Elective Course–GEC
5. Discipline Specific Elective-DSE
6. Ability Enhancement Compulsory Courses-AECC
7. Professional Core Courses-PCC
8. Professional Elective Courses-PEC
9. Research Project-RP(Minor & Major)
10. Internship (Industrial / Research)
11. MOCCS
12. Minor Certification Integrated with UG Degree

10. Medium of Instruction

The medium of instruction is ENGLISH for all courses, examinations, seminar presentations and project reports. Exception of dual medium for Diploma Engineering courses, if needed Hindi can be used for communication.

11. Choice Based Credit System (CBCS)/ LOCF/OBE

The university follows a flexible Choice based Credit System. Accordingly, the students shall

be given the option for selecting their courses, credits, teachers, slots and create their timetable. The student is given the option of selecting the number of credits to undergo in a semester, subject to the curriculum requirements of minimum and maximum. The student shall make the choice of course in consultation with the Class Coordinator and as stipulated from time to time.

12. Registration for Course in a Semester

A student will be eligible for registration of courses only if he/she satisfies the regulation of University norms and has cleared all dues to the University, Hostel and Library up to the end of the previous semester if student is not debarred from enrolment on disciplinary grounds. Except for the first-year courses, registration for a semester will be done during a specified week before the start of the semester as per the Academic Calendar.Late registration /enrolment will be permitted by the Dean of the School for genuine cases, on recommendation by the Head of the respective department, with a late fee as decided from time to time.

13. Attendance

The faculty handling a course must finalize the attendance, 3 calendar days before the last instructional day of the course and submit to the HoD through the class teacher.

a) A student with less than 75% attendance (Total Contact Hours-"TCH") in aggregate of all courses will not be permitted to appear for the end-semester examination of that semester, irrespective of the reason for the short fall of the attendance. The student is however permitted to avail Academic Leave up to 10% for attending academic related activities like, Industrial Visits, Seminars, Conferences, Competitions etc., with the prior approval of the HoD. After the event, the student should submit the relevant documents for proof to the HoD for approval of the Academic Leave.

b) The remaining 25% allowance in attendance is given to account for activities under NCC / NSS / Cultural / Sports / Minor Medical exigencies etc.

13.1 Condonation of Medical Cases

For medical cases, submission of complete medical history and records with prior information from the parent / guardian to Dean / HOD is mandatory. The assessment of such cases will be done by the attendance sub – committee on the merit of the case and put-up recommendations to the Vice–Chancellor. Such condo nation is permitted only twice for a student in then tire duration of the program.

The Vice-Chancellor, based on the recommendation of the attendance sub - committee may then give condonation of attendance, only if the Vice-Chancellor deems it fit and deserving. But in any case, the condonation cannot exceed 10%.

13.2 Additional Condonation

Additional condonation may be considered in rare and genuine cases which includes, approved leave for attending select NCC / Sports Camps, cases requiring prolonged medical treatment and critical illness involving hospitalization. For such select NCC / Sports Camps prior permission for leave shall be obtained by the respective faculty coordinator / Director of sports from the designated authority, before deputing the students.

14. Assessment Procedure

Engineering courses shall have two component so assessment namely,

a) "IA" for Internal Assessment: This assessment will be carried out throughout the

semester as per the Academic Schedule.

b) "EA" for External Assessment: This assessment will be carried out at the end of the Semester as per the Academic Schedule.

Table No: 1.6 : Weightage of the I A and E A for various categories of the courses.

S. No.	Category of Courses	IA Weightage	IA Minimum	ESE	ESE Minimum	Passing minimum (IA+ESE)
1	Theory Course	30%	---	70%	30%	40%
2	Practical Course	40%	---	60%	---	50%
3	Theory Course with Practical Components	30%	---	70%	30%	40%
4	Design/Semester Project	30%	---	70%	50%	50%
5	Student Discipline	100%	---	---	---	50%
6	Research Project (Major &Minor) and Viva Voce	30%	---	70%	50%	50%

14.1 Theory Assessment (IA & EA).

The general guidelines for the assessment of Theory Courses shall be done on a continuous basis is given as below.

Table 1.7: Weightage for theory Assessment

No.		Assessment Theory courses	Weightage Percentage wise of marks	Duration
1	IA	Sessional Exams	40%	Based on Credit
3		Assignments	20%	--
4		Attendance	20%	--
5		Seminar / Project / Surprise Test / Quiz etc.,	20%	--
6	EA	End Semester Exam / ESE	100%	Based on Credit

Total Assessment will be equal to IA+EA for theory

14.2 Practical Assessment (IA & EA)

The general guidelines for the assessment of Practical course shall be done on a continuous basis is given as below.

Table 1.8 : Weightage for Practical course Assessment

S. No.		AssessmentPractical Courses	Weightage Percentage wise of Marks	Duration
1	IA	Internal Assessment/ Practical Sessional Exam (Inc : Viva-voice)	50%	Based on Credit
2		Attendance in Lab during Semester & Lab Record/Practical Files/ Presentation / Case Study / Seminar/Project.	50%	--

3	EA	End Semester Exam/ESE	100%	Based on Credit

15. Research Project/ Semester Project Assessment Criteria

The general guidelines for assessment of Project are given in Table 1.9

Table No 1.9: Assessment pattern for Research Project / Semester Project

No.	Review / Examination scheme	Broad Guidelines	Weightage
1	First Review	Concept	10%
2	Second Review	Design	10%
3	Third Review	Experiment/Analysis	20%
4	Final Review/ESM	Project report and Viva – Voce, Results and Conclusion	60%

***Note–Novel Ideas shall be protected by IP Filling (Patent/Design/Copyright).**

16. Internship

A student has to compulsorily attend Summer / winter internship during semester breaks. In lieu of summer / Winter internship, the student is permitted to register for under taking case study / project work under a faculty of the University and carry out the project. In both the cases, the internship report in the prescribed format dulycertified by the faculty in-charge shall be submitted to the HoD. The evaluation will be done through presentation and viva. The course will have a Weightage as defined in the respective curriculum.

Table No 1.10: Assessment pattern for Internship

S.No.	Category	Weightage
1	Demo graphic Information	5%
2	Internship details/job description	25%
3	Future goals/career plans	5%
4	Learning outcomes	5%
5	Time line and responsibilities	10%
6	Leadership development plan	15%
7	Assessment & presentation	20%
8	Writing style	15%

17. For Non Credit Courses/Audit Courses

The assessment will be graded "Satisfactory/Not Satisfactory" and grades as Pass/Fail will be awarded. The Assessment will be done based on the respective assessment rubrics issued by the Head of the Department.

18. Credit Weightage

Credits are the weightages, assigned to the courses based on the following general pattern:

One Hour 1 credits.
Two Hour Practical 0.5 credits.

19. Maximum Duration of Program

A student may complete the program at a slower pace than the regular pace, but in any case, in not more than N+2 years. A student completing the degree programs in the extended period

will not be eligible for university ranking.

20. Maximum Gaps between semester/year

A student may be permitted by the Vice-Chancellor to withdraw from the entire programme for a maximum of two semesters for reasons of ill health, start – up venture or other valid reasons as recommended by a committee consisting of Head of Department, Dean of School, and Dean (Student Welfare).

21. Credit System & Grading CGPA/SGPA

IIMT-University implemented the choice-based credit system with a view to offer students choice of courses within a program with a flexibility to complete the program by earning credits at a pace decided by the students themselves. The system allowed students to choose inter-disciplinary, intra-disciplinary courses according to their learning needs, interest and aptitude. It was considered as a cafeteria approach and was expected to provide mobility to students.

As per the Current credit system practiced in institutions needs comprehensive reforms as they offer very little flexibility, choice and are less learner centric. Degrees offered today are more self-contained focusing on a specialization area and depend a lot on knowledge available with the faculty from the department only. Though the most requisite credit system does exist, wherein students are given a wide choice and flexibility, these exist as small islands in the vast ocean of thousands of educational institutes in India. In such institutions, the curriculum is frequently designed which is learner centric and offering a wide specialization area for students to pick and choose courses from.

The institutions shall make attempts wherein the design of the credit system and the teaching and evaluation modes shall be the responsibility of individual course teachers. The students should have the freedom to opt for courses from other specializations and not just from their core specialization. For this there has to be stronger collaborations between departments of the University and outside.

Most institutions follow the absolute grading system which is a simple procedure wherein the marks obtained by students correspond to a specific grade and grade point. It reflects the individual performance in a particular subject without any reference to the group/class. The absolute grading system has limitations and may be susceptible to some inconsistencies.

The relative grading system on the other hand provides relative performance of a student to a group/class wherein the student is ranked in a group/class on basis of relative level of achievement. In this system decisions are made in advance by the faculty members as to what proportion of students would be awarded a particular grade on the basis of their relative performance and which is done by assigning grades on basis of a normal curve. This facilitates comparative performance and eliminates negative effect of pass or fail.

Relative grading system may be used if the number of students registered for the course is at least 30. For a class of smaller size, an absolute grading scheme may be used. The statistical method may be used with adjustments to calculate the mean (M), median (Md) and standard deviation (SD) of the total marks (TM) obtained by the students registered for the course. If the mean and median coincide, the mean may be used for further computations, otherwise the median may be used. If suppose the mean is used, then the letter grades may be awarded based on the ranges specified in table below:*Table No: 1.11*

Table No:1.11

Letter Grade	Range

A+	TM>M+1.75SD
A	M+1.25 SD ≤TM<M+1.75SD
B+	M+0.75 SD ≤TM<M+1.25SD
B	M+0.25 SD ≤ TM < M+0.75 SD
C+	M-0.25 SD ≤ TM < M-0.25 SD
C	M-0.75 SD ≤ TM < M-0.25 SD
D+	M-1.25 SD ≤ TM < M-0.75 SD
D	M-1.75 SD ≤ TM < M-1.25 SD
E+	M-2.0 SD ≤ TM < M-1.75 SD
E	M-2.25 SD ≤ TM < M-2.0 SD
F	M-2.25 SD > TM
CO	Carry Over (Summer / Winter) due to Attendance deficiency (between 40% and 75%) and/or I. Lack of minimum IA marks as specified in clause 10.0 Table 3.
RA	Repeat the course due to (i) Lack of minimum attendance (below 40%) in regular course.
--	DETAINED "RC" or "RA" or both in all registered theory courses of a semester. The student is detained and has to repeat the entire semester. Clause 12.3

Letter grades may be improved based on the following scheme: Use the table above to determine grade boundaries. Look for natural gaps in the neighborhood of grade boundaries. Choose the largest gap in the neighborhood and make this as the grade boundary.

An 'E', 'E+' and 'F' grade may not be a purely relative grade. These may be assigned on the following basis:

- A minimum, say 30/100, may be set as pass marks for the course. A fail grade may then be awarded only if the Total Marks for the course are less than 30. Otherwise, the students may be awarded the Just Pass Grade D.
- A fail grade may be awarded to students whose marks are below the prescribed minimum even if the table above leads to a pass grade.

Similarly, a lower limit may be set for the A grade also, for instance greater than or equal to 86. Students not achieving the prescribed minimum may be awarded a lower letter grade even if the table above indicates otherwise. A pass grade may be made mandatory for both internal as well as external examinations in the case of a separate internal and external assessment,

a) Internal and External marks may be summed up with appropriate weightages to compute a total out of 100 marks. The letter grade may be assigned on this computed total.

b) Internal and external marks may be graded separately and then the assigned grade points may be used, with appropriate weightages, to compute a final grade point and letter grade.

Grading in the case of Re-evaluations, Retests and Remedial Examinations may be based on the following guidelines:

a) The ranges of marks once computed for awarding letter grades the first time, called the First Distribution (FD), will not be modified.

b) If a re-evaluation leads to a change in marks, then FD will be used to award an appropriate letter grade.

c) A retest may be permitted if

- A student gets a letter grade of E+ or E. In this case, irrespective of the marks obtained,

at most D grade may be awarded.

- A student is unable to complete course requirements because of certified illness or tragedy. In this case FD will be used to award an appropriate letter grade.

The use of relative grading system may be recommended in autonomous institutions, institutes of national importance and institutions with high ranking. The results of the relative grading system may be shared by such institutions later with other interested institutions to implement the same.

GPA and CGPA

GPA is the ratio of the sum of the product of the number of credits Ci of course "i "and the grade points Pi earned for that course taken over all courses "i" registered and successfully completed by the student to the sum of Ci for all "i". That is,

$$GPA = \frac{\sum_i C_i P_i}{\sum_i C_i}$$

CGPA will be calculated in a similar manner, in any semester, considering all the courses enrolled from the first semester onwards.

The Grade card will not include the computation of GPA and CGPA for courses with letter grade CO, RC and U until those grades are converted to the regular grades.

A course successfully completed cannot be repeated.

Grade Sheet

Based on the performance, each student is awarded a final letter grade at the end of the semester in each course. The letter grades and corresponding grade points are given in Table 1.11.

A student is considered to have completed a course successfully and earned credits if he/she secures a letter grade other than F, CO, RA in that course.

After results are declared, grade sheet will be issued to each student which will contain the following details:

a) Program and discipline for which the student has enrolled.
b) Semester of registration.
c) The course code, name of the course, category of course and the credits for each course registered in that semester
d) The letter grade obtained in each course
e) Semester Grade Point Average (GPA)
f) The total number of credits earned by the student up to the end of that semester in each of the course categories.
g) The Cumulative Grade Point Average (CGPA) of all the courses taken from the first semester.
h) Credits earned under Non CGPA courses.
i) Medium of Instruction is English.
j) Grade Equivalency.

22. Class/ Division

CGPA ≥ 8.0: First Class with distinction
6.5 ≤ CGPA <8.0: First Class
5.0 ≤ CGPA <6.5: Second Class.

23. Transfer of Credit / Academic Credit Bank

Within the broad framework of these regulations, the Academic Council, based on there commendation of the Credit Transfer Committee so constituted may permit students to transfer

part of the credit earned in other approved Universities of repute & status in the India or abroad.

The Academic Council may also approve admission of students who have completed a portion of course work in another approved Institute of repute under Multiple entry & Exit system, based on the recommendation of the credit transfer committee on a case-to-case basis.

Students who have completed coursework, at least first year, at some university other than the university to which transfer is sought (may request for transfer of admission to this university.

A student may be granted admission only through an admission process that will follow the same policy as for fresh admissions. However, a uniform credit system must be followed by all universities to effect transfer of credits.

Credit Transfer request can be submitted only after the student has been admitted in the concerned program and the following conditions are met:

The course work has been completed at a UGC approved and accredited University through fulltime formal learning mode.

a) The university accreditation grade/ ranking are not lower than that of the university to which the transfer is sought.
b) The courses prescribe to the common minimum syllabus under UGC CBCS system.
c) The letter grade obtained in the courses is "B" or better.
d) The number of credits to be transferred does not exceed the prescribed limit.
e) The program in question must have a similar credit system, in particular, modular or semester and the same numeric and letter grading system along with common meaning of the term "credit" in numerical terms.

The aspect of shelf life of courses needs to be considered while accepting credits as obsolescence of knowledge of certain field in terms of its current relevance needs to be investigated. The time lapsed between successful completion of certain courses of the program and the admission to which program transfer is sought needs to be considered. The maximum number of credit points that may be considered under a credit transfer needs to be specified. Contextual variables such as teaching-learning approach adopted, learning facilities offered, use of evaluation modes may also be considered while preparing the credit transfer policy.

24. Change of Discipline

a) If the number of students in any discipline of Engineering program as on the last instructional day of the First Semester is less than the sanctioned strength, then the vacancies in the said disciplines can be filled by transferring students from other disciplines subject to eligibility.
b) If any Student of Engineering program wants to change from Engineering to any program/ any discipline as per their eligibility they are permitted to change on or before 30 calendar days from the first day of commencement of program as per academic calendar.
c) All students who have successfully completed the first semester of the course will be eligible for consideration for change of discipline subject to the availability of vacancies and as per norms.
d) All such transfers will be allowed based on merit of the students. The decision of the Vice-Chancellor shall be final while considering such requests.

25. Use of Technological Intervention

With the proliferation of different types of access devices, especially mobile access devices,

technology has the potential to augment traditional classroom practices and revolutionize learning and evaluation methods. Technology, in fact can be an important driver to enable lifelong learning. Learning and engagement of students is facilitated by use of technology through several modes such as synchronous learning, semi-synchronous learning, blended learning, collaborative learning, flipped classroom etc. MOOC's, especially provided through SWAYAM, are a window of opportunity for lifelong learning and are offered through technology-based platforms. Learning management systems (LMS) may be used by institutions to integrate the entire teaching, learning and evaluation process. The Learning Management System may be used by institutions to deliver academic content in blended form and to assess learning through thesis, assignments etc. Open-source learning management systems such as Moodle, Edmodo may be used for posting content in the form of videos, audios, e-learning modules, live class sessions etc. Use of plagiarism detection software will be highly recommended to check originality of content.

In the conduct of examinations, universities face tremendous challenges such as need for trained manpower, distribution of question paper without delays and errors, delays in evaluation of answer scripts, lack of infrastructure to conduct examinations at a large scale, non-availability of faculty members for assessment, security issues faced during paper setting and paper distribution, tampering of certificates and answer scripts etc.

For a typical examination department of an institution will be an autonomous body right from registration of student to convocation through an integrated system. In fact, steps must be taken to implement a complete examination management system that considers the complete life cycle of examination process. The use of technology will reduce dependency on human intervention and be error free.

The following functions will be automated:

a) registration of students and generating unique PRN,
b) filling up of examination form,
c) generation of seat numbers and admit cards/hall tickets,
d) preparation of list of paper setter,
e) use of question bank system to draw question sets,
f) question paper generation,
g) online distribution of question papers on the day of examination with system of encryption,
h) Barcode system for answer books (this will eliminate issues related to errors, avoid malpractices etc.),
i) digitization of answer scripts and onscreen evaluation of answer sheets,
j) tracking of student's performance,
k) Marks submission through online software,
l) viewing of result through online system,
m) online verification and revaluation system,
n) digitization of certificates and marksheets (to avoid tampering and easy retrieval),
o) certificate authentication system,
p) Submission of various other applications through online system.

The above will lead to conduct of functions of the examination system in an efficient and transparent manner and timely availability of information to students.

26. Student Discipline

Every student is required to observe utmost discipline and decorum both inside and outside the campus and not to indulge in any activity which may affect adversely the prestige reputation of

the University.

27. Student Welfare

Any act of indiscipline of a student reported to the Dean (Students Welfare) and Head of the Department will be referred to a Discipline Committee constituted for the purpose. The Committee will enquire into the charges and decide on a suitable punishment if the charges are substantiated. The committee will also authorize the Dean (Students Welfare) to recommend to the Vice-Chancellor for the implementation of the decision. The student concerned may appeal to the Vice-Chancellor, whose decision will be the final.

28. Ragging

Ragging in any form is a criminal and non-bailable offence in our country. The current State and Central legislations provide stringent punishments including imprisonment. Once the involvement of a student(s) is established in ragging, offending fellow students/staff, harassment of any nature to the fellow students/staff etc. the student(s) will be liable to be dismissed from the University, as per the laid down procedures of the UGC / Govt. /Institute. Every senior student at the University, along with their parent, shall give an undertaking every year in this regard and the same should be submitted at the time of Registration.

29. Power of Modify

Not with standing all that has been stated above, the Academic Council is vested with powers to modify any or all the above regulations from time to time, if required, subject to the approval by the Board of Studies and Final approval by Vice-Chancellor.

30. Exit Point

Refer to point 8

31. NC/Credit Course

Please refer to point 17 for NC (Non Credit Courses). Refer to Evaluation schemes for Credit Courses.

32. Any other heading as per your Program

NA

Evaluation Scheme

Evaluation Scheme – Bachelor of Technology (Mechanical Engineering)
Year: I / Semester: I

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	ENAS-111	MATHEMATICAL THINKING WITH CALCULUS AND LINEAR ALGEBRA	Th	Core-1	3	1	0	4	30	20	50	100	150
2.	ENAS-112	MODERN PHYSICS IN ENGINEERING	Th	Core -2	3	1	0	4	30	20	50	100	150
	ENAS-113	ENGINEERING CHEMISTRY											
3.	ENME-111N	FUNDAMENTALS OF MECHANICAL AND MECHATRONICS SYSTEMS	Th	Core -3	3	1	0	4	30	20	50	100	150
4.	ENCS-111	STRUCTURED PROGRAMMING AND PROBLEM SOLVING IN C	Th	VAC-1	3	1	0	4	30	20	50	100	150
5.	ENAS-114	PROFESSIONAL COMMUNICATION AND DIGITAL FLUENCY	Th	AECC-1	3	1	0	4	30	20	50	100	150
	ENHU -112	ENVIRONMENT, ECOLOGY AND SUSTAINABILITY		AECC-2									
6.	ENAS-112P	MODERN PHYSICS IN ENGINEERING LAB	P	LAB-1	0	0	2	1	0	15	15	35	50
	ENAS-113P	ENGINEERING CHEMISTRY LAB											
7.	ENCS-111P	PROGRAMMING WITH C LAB: HANDS ON LOGIC BUILDING	P	LAB-2	0	0	2	1	0	15	15	35	50
8.	ENAS-114P	PROFESSIONAL COMMUNICATION AND DIGITAL FLUENCY	P	LAB-3	0	0	2	1	0	15	15	35	50
	ENHU -112P	ENVIRONMENT, ECOLOGY AND SUSTAINABILITY LAB											
9.	ENME-113P	INTRODUCTION TO CNC AND 3-D PRINTER LAB	P	SEC-1	0	0	2	2	0	15	15	35	50
10.	ENME-112P	MECHANICAL WORKSHOP LAB	P	LAB-5	0	0	2	1	0	15	15	35	50
	ENME-113P	ENGINEERING GRAPHICS & DESIGN LAB											
11.	ENPH-111	SPIRITUAL AND CULTURAL HERITAGE: INDIAN EXPERIENCE	P	AC	0	0	0	NC*	0	25*	25*	0	25*
12.	NECC -112*	UNIVERSITY SOCIAL RESPONSIBILITY - COMMUNITY OUTREACH	P	AC	0	0	0	NC*	0	25*	25*	0	25*
13.	SPNC-111*	SPORTS	P	AC	0	0	0	NC*	0	25*	25*	0	25*

Total			**15**	**5**	**10**	**26**	**150**	**175**	**325**	**675**	**1000**

TH- Theory paper, P-Practical, L-Lecture, T-Tutorials, C-Credit, AECC – Ability Enhancement Compulsory Course, AC – Audit Courses, NC*-No Credit Course, CT – Class Test (Sessional Examinations), TA – Teacher's Assessment, ESE – End Semester Examinations.

University Social Responsibility& Sports - Community Outreach and Sports, Spiritual And Cultural Heritage: Indian Experience are Non-Credit Qualifying Courses. Their marks will not be added in final marks.

Note: NCC is offered as General Elective.

Note: A total of 8 Credits are mandatory to earn from NPTEL/Moocs/Coursers etc during 4 years of B.Tech Program.

Evaluation Scheme – Bachelor of Technology (Mechanical Engineering)
Year: I / Semester: II

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	ENAS-121	APPLIED DIFFERENTIAL EQUATIONS	Th	Core-4	3	1	0	4	30	20	50	100	150
2.	ENAS-123	ENGINEERING CHEMISTRY	Th	Core-5	3	1	0	4	30	20	50	100	150
	ENAS-122	MODERN PHYSICS IN ENGINEERING											
3.	ENEE-121	ELECTRICAL & ELECTRONICS IN THE MODERN WORLD	Th	Core-6	3	1	0	4	30	20	50	100	150
4.	ENCS-121	FUNDAMENTAL CONCEPTS AND PROBLEM SOLVING WITH PYTHON	Th	VAC-2	3	1	0	4	30	20	50	100	150
5.	ENAS-124	PROFESSIONAL COMMUNICATION AND DIGITAL FLUENCY	Th	AECC-2	3	1	0	4	30	20	50	100	150
	ENHU -112	ENVIRONMENT, ECOLOGY AND SUSTAINABILITY		AECC-1									
6.	ENAS-123P	ENGINEERING CHEMISTRY LAB	P	LAB-6	0	0	2	1	0	15	15	35	50
	ENAS-122P	MODERN PHYSICS IN ENGINEERING LAB											
7.	ENCS-121P	FUNDAMENTAL CONCEPTS AND PROBLEM SOLVING WITH PYTHON LAB	P	LAB-7	0	0	2	1	0	15	15	35	50
8.	ENAS-124P	PROFESSIONAL COMMUNICATION AND DIGITAL FLUENCY LAB	P	LAB-8	0	0	2	1	0	15	15	35	50
	ENHU-112P	ENVIRONMENT, ECOLOGY AND SUSTAINABILITY LAB											
9.	ENEE-121P	ELECTRICAL & ELECTRONICS IN THE	P	LAB-4	0	0	2	1	0	15	15	35	50

		MODERN WORLD LAB											
10.	ENME-123P	ENGINEERING GRAPHICS & DESIGN LAB	P	LAB-9	0	0	2	1	0	15	15	35	50
	ENME-122P	MECHANICAL WORKSHOP LAB											
11.	ENHW-121	HEALTH AND WELLNESS	P	AC	0	0	0	NC*	0	25*	25*	0	25*
12.	NECC-121*	INDUSTRIAL VISIT / SEMINAR ON THE REPORT OF VISIT	P	AC	0	0	0	NC*	0	25*	25*	0	25*
13.	NECC -122*	UNIVERSITY SOCIAL RESPONSIBILITY - COMMUNITY OUTREACH	P	AC	0	0	0	NC*	0	25*	25*	0	25*
14.	SPWC-111	SPORTS	P	LAB-10	0	0	2	1	0	0	0	25	25
Total					**15**	**5**	**12**	**26**	**150**	**175**	**325**	**700**	**1025**
TH- Theory paper, P-Practical, L-Lecture, T-Tutorials, C-Credit, AECC – Ability Enhancement Compulsory Course, AC – Audit Courses, NC*-No Credit Course, CT – Class Test (Sessional Examinations), TA – Teacher's Assessment, ESE – End Semester Examinations.													
University Social Responsibility - Community Outreach and Sports, Industrial Visit, Health and Wellness are Non-Credit Qualifying Courses. Their marks will not be added in final marks.													
Note: NCC is offered as General Elective													

Note: A total of 8 Credits are mandatory to earn from NPTEL/Moocs/Coursers etc during 4 years of B.Tech Program.

Evaluation Scheme – Bachelor of Technology (Mechanical Engineering)
Year: II / Semester: III

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	RTAS-231/ RESE-231-239	Engineering Mathematics-III/ Engineering Science Electives**	Th	Core-7	3	1	0	4	30	20	50	100	150
2.	RTME-231	Material Science	Th	Core-8	3	1	0	4	30	20	50	100	150
3.	RTME -232	Engineering Thermodynamics	Th	Core-9	3	1	0	4	30	20	50	100	150
4.	RTME -233	Strength of Material	Th	Core-10	3	1	0	4	30	20	50	100	150
5.	RSEE-231	Introduction to MAT LAB	Th	SEC-3	3	0	0	2	10	5	15	35	50
6.	RTME -231P	Material Science Lab	P	LAB-11	0	0	2	2	0	15	15	35	50
7.	RTME -232P	Engineering Thermodynamics Lab	P	LAB-12	0	0	2	2	0	15	15	35	50
8.	RTME -233P	Strength of Material Lab	P	LAB-13	0	0	2	2	0	15	15	35	50
9.	RTAS-232P	Integrative Communication Lab	P	AECC-3	0	0	2	2	0	15	15	35	50
10.	*NECC-232	University Social Responsibility - Community Outreach	P	AC	*0*	*0*	*0*	*NC**	*0*	*25**	*25**	0	*25**

11.	SPT-PC-111	Sports	P	AC	*0*	*0*	*0*	*NC**	*0*	*50**	*50**	0	*50**
Total					**15**	**4**	**8**	**26**	**130**	**145**	**275**	**575**	**850**
L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, SEC- Skill Enhancement Course, Th- Theory, ESE- End Semester Examination, AC- Audit course													
Note: NECC-232 & SPT-231 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of social visits/awareness campaigns/ awareness rallies & participation in sports activity respectively during the semester. Student needs to qualify it but the marks will not be added in total marks													
Note: NCC is offered as General Elective													

Note: A total of 8 Credits are mandatory to earn from NPTEL/Moocs/Coursers etc during 4 years of B.Tech Program.

Evaluation Scheme – Bachelor of Technology (Mechanical Engineering)
Year: II / Semester: IV

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	RESE-241-RESE-249 / RTAS-241	Engineering Science Electives**/ Mathematics-III	Th	Core-11	3	1	0	4	30	20	50	100	150
2.	RTME-241	Fluid Mechanics	Th	Core-12	3	1	0	4	30	20	50	100	150
3.	RTME -242	Manufacturing Processes	Th	Core-13	3	1	0	4	30	20	50	100	150
4.	IEMM-402/ASNL-402	Indian Ethos & Management/ Ancient Sanskrit language	Th	VAC-3	3	0	0	2	10	05	15	35	50
5.	RDME-241-RDME-244	DSE-1	Th	DSE-1	3	1	0	4	30	20	50	100	150
6.		Generic Elective-1	Th	GE-1	4	0	0	4	30	20	50	100	150
7.	RTME-241P	Fluid Mechanics Lab	P	LAB-14	0	0	2	2	0	15	15	35	50
8.	RTME-242P	Manufacturing Processes Lab	P	LAB-15	0	0	2	2	0	15	15	35	50
9.	RTME-243P	Machine Drawing Lab	P	LAB-16	0	0	2	2	0	15	15	35	50
10.	NECC-241	Industrial Visit/ Seminar/Presentation on the report of visits	P	AC	*0*	*0*	*0*	*NC**	*0*	*25**	*25**	*0*	*25**
11.	NECC-242	University Social Responsibility - Community Outreach	P	AC	*0*	*0*	*0*	*NC**	*0*	*25**	*25**	*0*	*25**
12.	SPT-PC-111	Sports	P	LAB-17	0	0	2	2	0	15	15	35	50
Total					**19**	**4**	**10**	**30**	**160**	**165**	**325**	**675**	**1000**
#Minor Certification Paper-I					3	1	0	4	30	20	50	100	150
L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, DSE- Discipline Specic Elective, Th- Theory, ESE- End Semester Examination, AC- Audit course													

*Note: NECC-241, NECC-242 & SPT-241 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies & participation in sports activity respectively during the semester. Student needs to qualify it but the marks will not be added in total marks	
Discipline Specific Electives -1	1. RDME-241 Applied Thermodynamics 2. RDME -242 Operation Research 3. RDME -243 Renewable Energy Source 4. RDME -244 Supply Chain Management 5. RDME- 245 Introduction to Solidworks
Generic Electives-1	This subject will be opted by student from other School of the IIMT University
Note: NCC is offered as General Elective	

Most Important regarding internship: A minimum of 4-5 weeks internship is to be completed during summer break and its assessment will be done in 5th semester.
#Minor Certification will be choice based and the student choosing any minor certification course has to clear all the three papers in three semesters (IV/ V/ VI Semester).

Note: A total of 8 Credits are mandatory to earn from NPTEL/Moocs/Coursers etc during 4 years of B.Tech Program.

Evaluation Scheme – Bachelor of Technology (Mechanical Engineering)
Year: III / Semester: V

S. No	Subject Code	Subject Name	Evaluation Scheme									
			Periods			Internal Marks			External Marks		Total Marks	Credits
			L	T	P	CT	TA	IP	ET	EP		
1	SEME-351	Fluid Machinery	4	1	0	30	20	0	100	0	150	4
2	SEME-352	Heat & Mass Transfer	4	1	0	30	20	0	100	0	150	4
3	SEME-353	Production Technology	4	1	0	30	20	0	100	0	150	4
4	SDME-351/ SDME-354	DSE-II	4	0	0	30	20	0	100	0	150	4
5	SEME-351P	Fluid Machinery Lab	0	0	3	0	0	20	0	30	50	2
6	SEME-352P	Heat & Mass Transfer Lab	0	0	3	0	0	20	0	30	50	2
7	SEME-353P	Production Technology Lab	0	0	3	0	0	20	0	30	50	2
8	SEME-354P	Internship	0	0	2	0	0	50	0	0	50	2
9	SEME-359P	Research Project-I	0	0	2	0	0	50*	0	0	50*	*NC**
10	NECC-352*	University Social Responsibility	*0*	*0*	*0*	*0*	*0*	*25**	*0*	*0*	*25**	*NC**
11	SPT-351*	SPORTS	*0*	*0*	*0*	*0*	*0*	*50**	*0*	*0*	*50**	*NC**
		Grand Total	**16**	**03**	**13**	**120**	**80**	**110**	**400**	**90**	**800**	**24**

		#**Minor Certification Paper-II**	3	1	0	30	20	0	100	0	150	4

L- Lecture, T- tutorials, P- Practical (Labs), CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), IP- Internal Practical, ET- External Theory, EP- external Practical, NC- Non Credit Course

*Note: NECC-352 & SPT-351 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of social visits/awareness campaigns/ awareness rallies & participation in sports activity respectively during the semester. Student needs to qualify it but the marks will not be added in total marks

Engineering Courses (Core)	Fluid Machinery, Heat & Mass Transfer, Production Technology, Fluid Machinery Lab, Heat & Mass Transfer Lab, Production Technology Lab
Discipline Specific Elective-II	1. SDME-351 I.C.Engines & Compressors 2. SDME-352 Finite Element Methods 3. SDME-353 Industrial Engineering 4. SDME-354 Gas Dynamics and Jet Propulsion
Research Project	Research Project-I
Skill Enhancement Courses	University Social Responsibility, SPORTS, Internship

#**Minor Certification will be choice based and the student choosing any minor certification course has to clear all the three papers in three semesters (IV/ V/ VI Semester).**
Note: A total of 8 Credits are mandatory to earn from NPTEL/Moocs/Coursers etc during 4 years of B.Tech Program.

Evaluation Scheme – Bachelor of Technology (Mechanical Engineering)
Year: III / Semester: VI

S. No	Subject Code	Subject Name	Evaluation Scheme									
			Periods			Internal Marks			External Marks		Total Marks	Credits
			L	T	P	CT	TA	IP	ET	EP		
1	SEME-361	Theory of Machines	3	1	0	30	20	0	100	0	150	4
2	SEME-362	Refrigeration & Air Conditioning	3	1	0	30	20	0	100	0	150	4
3	SDME-361/ SDME-364	DSE-III	3	1	0	30	20	0	100	0	150	4
4	UVE-601	Universal Human Values & Professional Ethics	3	0	0	10	05	0	35	0	50	3
5	SEME-361P	Theory of Machines Lab	0	0	3	0	0	20	0	30	50	2
6	SEME-362P	Refrigeration & Air Conditioning- Lab	0	0	3	0	0	20	0	30	50	2
7	SEME-363P	Mini Project Lab	0	0	3	0	0	50	0	0	50	2
8	NECC-365	MOOCS (SWAYAM/NPTEL)	0	0	2	0	0	50	0	0	50	2
9	SEME-369P	Research Project-II	0	0	2	0	0	50*	0	0	50*	NC*

10	NECC-361*	Industrial Visit/ Seminar/Presentation on the report of visits	0	0	0	0	0	25*	0	0	25*	NC*
11	NECC-362*	University Social Responsibility	0	0	0	0	0	25*	0	0	25*	NC*
12	*SPT-361*	SPORTS	0	0	0	0	0	50*	0	0	50*	NC*
		Grand Total	**12**	**03**	**11**	**100**	**65**	**140**	**335**	**60**	**700**	**23**
13		**#Minor Certification Paper-III**	2	0	0	30	20	0	100	0	150	2

L- Lecture, T- tutorials, P- Practical (Labs), CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), IP- Internal Practical, ET- External Theory, EP- external Practical, NC- Non Credit Course

*Note: NECC-361, NECC-362 & SPT-361 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies & participation in sports activity respectively during the semester. Student needs to qualify it but the marks will not be added in total marks

Engineering Courses (Core)	Theory of Machines, Refrigeration & Air Conditioning, Theory of Machines Lab Refrigeration & Air Conditioning- Lab
Discipline Specific Elective-III	1. SDME-361 Mechanical Vibrations 2. SDME-362 Unconventional Machining Processes 3. SDME-363 Machine Design 4. SDME-364 Artificial Intelligence
Ability Enhancement Courses	Universal Human Values & Professional Ethics
Research Project	Research Project-II
Skill Enhancement Courses	University Social Responsibility, SPORTS, Mini Project Lab, Python Programming, MOOCS (SWAYAM/NPTEL)

Most Important regarding internship: A minimum of 4-5 weeks internship is to be completed during summer break and its assessment will be done in 5th semester.

#Minor Certification will be choice based and the student choosing any minor certification course has to clear all the three papers in three semesters (IV/ V/ VI Semester).

Note: A total of 8 Credits are mandatory to earn from NPTEL/Moocs/Coursers etc during 4 years of B.Tech Program.

Evaluation Scheme – Bachelor of Technology (Mechanical Engineering)
Year: IV / Semester: VII

S. No	Subject Code	Subject Name	Evaluation Scheme									
			Periods			Internal Marks			External Marks		Total Marks	Credits
			L	T	P	CT	TA	IP	ET	EP		
1	SEME-471	CAD/ CAM	3	1	0	30	20	0	100	0	150	4
2	GE-II	Generic Elective-II	3	1	0	30	20	0	100	0	150	4
3	SEME-471P	CAD/ CAM Lab	0	0	3	0	0	20	0	30	50	2
4	SEME-472P	Minor Project	0	0	8	0	0	40	0	60	100	4

5	SEME-474P	Internship	0	0	2	0	0	100	0	0	100	2
6	NECC-475	MOOCS (SWAYAM/NPTEL)	0	0	2	0	0	50	0	0	50	2
7	NECC-472*	University Social Responsibility	*0*	*0*	*0*	*0*	*0*	*25**	*0*	*0*	*25**	*NC**
8	SPT-471*	SPORTS	*0*	*0*	*0*	*0*	*0*	*50**	*0*	*0*	*50**	*NC**
		Grand Total	**6**	**02**	**15**	**60**	**40**	**210**	**200**	**90**	**600**	**18**

L- Lecture, T- tutorials, P- Practical (Labs), CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), IP- Internal Practical, ET- External Theory, EP- external Practical, NC- Non Credit Course

*Note: NECC-352 & SPT-351 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of social visits/awareness campaigns/ awareness rallies & participation in sports activity respectively during the semester. Student needs to qualify it but the marks will not be added in total marks

Engineering Courses (Core)	CAD / CAM, CAD/ CAM Lab
Discipline Specific Elective-IV	1. SDME-471- Mechatronics 2. SDME-472- Additive Manufacturing 3. SDME-473- HVAC Systems 4. SDME-474- Tribology
Generic Elective-II	This subject will be opted by student from other department of the IIMT University
Skill Enhancement Courses	University Social Responsibility, SPORTS, Internship, Minor Project

Note: A total of 8 Credits are mandatory to earn from NPTEL/Moocs/Coursers etc during 4 years of B.Tech Program.

Evaluation Scheme – Bachelor of Technology (Mechanical Engineering)
Year: IV / Semester: VIII

S. No	Subject Code	Subject Name	Evaluation Scheme									
			Periods			Internal Marks			External Marks		Total Marks	Credits
			L	T	P	CT	TA	IP	ET	EP		
1	GE-III	Generic Elective-III	3	1	0	30	20	0	100	0	150	4
2	SDME-481/ SDME-484	DSE-IV	3	1	0	30	20	0	100	0	150	4
3	SEME-481P	Major Project	0	0	20	0	0	100	0	150	250	10
		Grand Total	**06**	**02**	**20**	**60**	**40**	**100**	**200**	**150**	**550**	**18**

L- Lecture, T- tutorials, P- Practical (Labs), CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), IP- Internal Practical, ET- External Theory, EP- external Practical, NC- Non Credit Course

*Note: NECC-352 & SPT-351 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of social visits/awareness campaigns/ awareness rallies & participation in

sports activity respectively during the semester. Student needs to qualify it but the marks will not be added in total marks	
Generic Elective-III	This subject will be opted by student from other department of the IIMT University
Discipline Specific Elective-V	1. SDME-481 Non-destructive Testing 2. SDME-482 Flexible Manufacturing System 3. SDME-483 Power Plant Engineering 4. SDME-484 Automobile Engineering
Research Project	Major Project

Note: A total of 8 Credits are mandatory to earn from NPTEL/Moocs/Coursers etc during 4 years of B.Tech Program.

****ENGINEERING SCIENCE OPEN ELECTIVES**

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	RESE-231/RESE-241	Introduction to Construction Material	Th	ESOE	3	1	0	4	30	20	50	100	150
2.	RESE-232/RESE-242	Environmental Law and Policy	Th	ESOE	3	1	0	4	30	20	50	100	150
3.	RESE-233/RESE-243	Introduction to AI	Th	ESOE	3	1	0	4	30	20	50	100	150
4.	RESE-234/RESE-244	Soft Computing	Th	ESOE	3	1	0	4	30	20	50	100	150
5.	RESE-235/RESE-245	Introduction to IOT	Th	ESOE	3	1	0	4	30	20	50	100	150
6.	RESE-236/RESE-246	Renewable Energy	Th	ESOE	3	1	0	4	30	20	50	100	150
7.	RESE-237/RESE-247	Basics of Thermal Engineering	Th	ESOE	3	1	0	4	30	20	50	100	150
8.	RESE-238/RESE-248	Material Science	Th	ESOE	3	1	0	4	30	20	50	100	150

S. No	Subject Code	Subject Name	Remark
1	RESE-231/ RESE-241	Introduction to Construction Material	Subject can be offered to any branch except CE
2	RESE-232/ RESE-242	Environmental Law and Policy	
3	RESE-233/ RESE-243	Introduction to A.I.	Subject can be offered to any branch except CS
4	RESE-234/ RESE-244	Soft Computing	
5	RESE-235/ RESE-245	Introduction to IOT	Subject can be offered to any branch except EE
6	RESE-236/ RESE-246	Renewable Energy	
7	RESE-237/ RESE-247	Basics of Thermal Engineering	Subject can be offered to any branch except ME
8	RESE-238/ RESE-248	Material Science	

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CBCS: Statement of Credit distribution (w.e.f: Session 2024-25)

College/School: School of Engineering & Technology
Programme: B.Tech
Duration: 8 Semester **Annual/Semester: Semester**
Credit range: 160-190 (Suggested by CBCS Committee)

COURSE	CREDIT	SEMESTER	CORE COURSE Major	DSE Minor	AECC	SEC	GE (Th 4) Interdisciplinary	General Elective	Value Added Course (VAC)	Industrial Training/ Survey / Research Project	Total Credits
No Exit Allowed	26	I	C-1 (4 Credit) C-2 (4 Credit)+P-01(1Credit) C-3 (4 Credit)+P-02(1Credit)		AECC-1 (4Credit)+ P-04 (1Credit)	SEC-1 P-(2 Credit)		NCC	VAC-1 (4 Credit) + P-9(1Credit)		26
	28	II	C-4 (4 Credit) C-5 (4 Credit)+P-05(1Credit) C-6 (4 Credit)+P-06(2Credit) P-8 (1 Credit)		AECC-2 (4Credit)+ P-04 (1Credit)	SEC-2 P-(2 Credit)		NCC	VAC-2 (4 Credit) + P-9(1Credit)		28
Certificate in Engineering	26	III	C-07(4 Credit) C-8 (4 Credit)+P-10(2 Credit) C-9 (4 Credit)+P-11(2 Credit) C-10 (4Credit)+P-12(2 Credit)		AECC-3 (P- 2Credit)	SEC-3 (2 Credit)		NCC			26
	28	IV	C-11(4 Credit) C-12 (4 Credit)+P-13(2 Credit) C-13 (4 Credit)+P-14(2 Credit)	DSE-1 (4 Credit)			GE-1 (4 Credit)	NCC	VAC-3 (2 Credit)		28

			P-15(2 Credit)								
Diploma in Engineering	26	V	C-14 (4 Credit)+P-16(2 Credit) C-15 (4 Credit)+P-17(2 Credit) C-16 (4 Credit)+P-18(2 Credit)	DSE-2 (4 Credit)		SEC-4 (2 Credit)		NCC		INT-1 (2 Credit) RP-I (NC*)	26
	20	VI	C-17 (4 Credit)+P-19(2 Credit) C-18 (4 Credit)+P-20(2 Credit)	DSE-3 (4 Credit)	AECC-4 (2 Credit)	SEC-5 (2 Credit)		NCC		RP-II(NC*)	20
B.Tech (Degree)	18	VII	C-19 (4 Credit)+P-21(2 Credit)			SEC-6 (2 Credit)	GE-2 (4 Credit)	NCC		INT-2 (2 Credit) Minor Project (4 Credit)	18
	18	VIII		DSE-4 (4 Credit)			GE-3 (4 Credit)	NCC		Major Project (10 Credit)	18
			19(Th)*4(C) = 76 04(Pr)*01(C) = 04 13(Pr)*2(C) = 26 **Total = 106**	4(Th)*4(C) =16 **Total =16**	02(Th)*04(C)=8 02(Pr)*01(C)=02 01(Pr)*02(C)=02 01(Th)*02(C)=02 **Total =14**	02(Pr)*02(C)=4 04(Th)*02(C)=8 **Total =12**	03(Th)*04(C)=12 **Total =12**		02(Th)*04(C)=8 02(Pr)*01(C)=02 01(Th)*02(C) =02 **Total =12**	2+2+4+10=18 **Total =18**	**190**

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IIMTU-NEP Implementation: (w.e.f. Session 2024-25)
(B.Tech Mechanical Engineering)

Programm	Year	Semester (15 weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester	Prerequisite	Elective (For other faculty)
CERTIFICATE COURSES B.Tech. MECHANICAL ENGINEERING	FIRST YEAR	SEMESTER –I	i) Core-1 (Th.4C)	4	5	45	Engineering Mathematics –I	5		SOBST
			ii) AECC-1 (Th.4 C+ P 1 C)	4 1	4 2	45 30	Effective Engineering Communication / Environment and Ecology Effective Engineering Communication Lab / Environment and Ecology Lab	5		
			iii) Core-2 (Th.4 C + P 1 C).	4 1	5 2	45 30	Engineering Physics / Engineering Chemistry Engineering Physics Lab / Engineering Chemistry Lab	5		SOBST
			iv) Core-3 (Th. 4 C)	4	5	45	Introduction to Electrical and Electronics Engineering / Fundamentals of Mechanical and Mechatronics Systems	5		
			v) VAC-1 (Th.4 C + P 1 C)	4 1	5 2	45 30	Structured Programming and Problem Solving in C Structured Programming and Problem Solving in C lab	5		
			vi) SEC-1(P 2C)/ Lab-4	2	2	30	Introduction to CNC and 3-D Printer Lab / Introduction to Electrical and Electronics Engineering Lab			
			vii) Lab-5 (P 1 C)	1	2	30	Mechanical Workshop Lab / Engineering Graphics & Design Lab			
			viii) Audit Course	NC	-	-	University Social Responsibility - Community Outreach			
			ix) Audit Course	NC	-	-	Sports			
			i) Core-4 (Th.4C)	4	5	45	Engineering Mathematics –II	5		SOBST
			ii) AECC-2 (Th.4 C+ P 1 C)	4 1	4 2	45 30	Environment and Ecology / Effective Engineering Communication Environment and Ecology Lab / Effective Engineering Communication Lab	5		

		SEMESTER - II	iii) Core-5 (Th.4 C + P 1 C)	4 1	5 2	45 30	Engineering Chemistry/ Engineering Physics Engineering Chemistry Lab/ Engineering Physics Lab	5		SOBST
			iv) Core-6 (Th. 4 C)	4	5	45	Introduction to Electrical and Electronics Engineering / Fundamentals of Mechanical and Mechatronics Systems	5		
			v) VAC-2 (Th.4 C + P 1 C)	4 1	5 2	45 30	Fundamental Concepts and Problem Solving with Python Fundamental Concepts and Problem Solving with Python Lab	5		
			vi) SEC-1(P 2C)/ Lab-4	2	2	30	Introduction to CNC and 3-D Printer Lab / Introduction to Electrical and Electronics Engineering Lab			
			vii) Lab-9 (P 1 C)	1	2	30	Mechanical Workshop Lab / Engineering Graphics & Design Lab			
			viii) SEC-2 (P 2 C)	2	2	30	Advance Industrial training in 'C' Lab			
			ix) Audit Course	NC	-	-	Industrial Visit / Seminar on the report of visit			
			x) Audit Course	NC	-	-	University Social Responsibility - Community Outreach			
			xi) Lab-10 (P 1 C)	2	3	30	Sports			
Note: A total of 8 Credits are mandatory to earn from NPTEL/Moocs/Coursers etc during 4 years of B.Tech Program.										
Programme Outcomes: PO_1 - PO_{12} **[ANNEXTURE-1]**							**Programme Specific Outcomes:** PSO_1 -PSO_4 **[ANNEXTURE-2]**			

Programm	Year	Semester (15 weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester)	Prerequisite	Elective (For other faculty)
	SECOND YEAR	SEMESTER –III	i) Core-7 (Th. 4 C)	4	5	45	Engineering Mathematics-III/Engineering Science Electives**	5		
			ii) Core-8 (Th. 4 C + P 2 C)	4 2	5 3	45 30	Material Science Material Science Lab	5		
			iii) Core-9 (Th. 4 C + P 2 C)	4 2	5 3	45 30	Engineering Thermodynamics Engineering Thermodynamics Lab	5		

			iv) Core-10 (Th. 4 C + P 2 C)	4 2	5 3	45 30	Strength of Material Strength of Material Lab	5		
			v) SEC-3 (Th. 4 C)	2	3	30	Introduction to MAT LAB	5		
			Vi) AECC-3 (P 2 C)	2	3	30	Interactive Communication	5		SOAH
			vii) Audit Course	NC	-	-	University Social Responsibility - Community Outreach			
			viiI) Audit Course	NC	-	-	Sports			
		SEMESTER – IV	i) Core-11 (Th. 4 C)	4	5	45	Engineering Science Electives**/ Engineering Mathematics-III	5		
			ii) Core-12 (Th. 4 C + P 2 C)	4 2	5 3	45 30	Fluid Mechanics Fluid Mechanics Lab	5		
			iii) Core-13 (Th. 4 C + P 2 C)	4 2	5 3	45 30	Manufacturing Processes Manufacturing Processes Lab	5		
			iV) VAC-3 (Th. 2 C)	2	3	30	1. Indian Ethos and Modern Management, 2. Ancient Sanskrit Language (CSU Delhi)	5		
			v) DSE-1 (Th. 4 C)	4	5	45	1. Applied Thermodynamics 2. Operation Research 3. Renewable Energy Source 4. Supply Chain Management 5. Introduction to Solidworks	5		
			vi) GE-1 (Th. 4 C)	4	5	45	GE-1 (To be opted from other school)	5		
			vii) LAB-16 (P 2 C)	2	3	30	Machine Drawing Lab			
			viii) Audit Course	NC	-	-	Industrial Visit / Seminar on the report of visit			
			ix) Audit Course	NC	-	-	University Social Responsibility - Community Outreach			
			x) Lab-17 (P 1 C)	2	3	30	Sports			
*** Industrial Training of 4 Weeks/5Weeks to be completed between the semester break**							**#Minor Certification Paper-I**			

Note: A total of 8 Credits are mandatory to earn from NPTEL/Moocs/Coursers etc during 4 years of B.Tech Program.

Programme Outcomes:
PO_1 – PO_{12} **[ANNEXTURE-1]**

Programme Specific Outcomes:
PSO_1 –PSO_4 **[ANNEXTURE-2]**

Programme	Year	Semester (15 weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester)	Prerequisite	Elective (For other faculty)
	THIRD YEAR	SEMESTER –V	i) C16 (Th. 4 Cr. + P 2 Cr.) ii) SEC-4 iii) DSE-2	4 2 2 4	4 3 2 4	45 24 24 45	Fluid Machinery Fluid Machinery Lab Internship* I.C. Engines & Compressors Finite Element Methods Industrial Engineering Gas Dynamics and Jet Propulsion	5 5		
			i) C17 (Th. 4 Cr. + P 2 Cr.)	4 2	4 3	45 24	Heat & Mass Transfer Heat & Mass Transfer Lab	5		
			i) C18 (Th. 4 Cr. + P 2 Cr.)	4 2	4 3	45 24	Production Technology Production Technology Lab	5		
		SEMESTER – VI	i) C19 (Th. 4 Cr. + P 2Cr.) ii) SEC-5 iii) DSE-3	4 2 2 4	4 3 4 4	40 24 32 40	Theory of Machines Theory of Machines Lab MOOCS (SWAYAM/ NPTEL) Mechanical Vibrations Unconventional Machining Processes Machine Design Artificial Intelligence	5 5		
			i) C20 (Th. 4 Cr. + P 2Cr.)	4 2	4 3	40 24	Refrigeration & Air Conditioning Refrigeration & Air Conditioning Lab	5		
			i) AECC (Th. 3Cr) ii) SEC-6	3 2	4 3	40 24	Universal Human Values & Professional Ethics Mini Project	5		
*** Industrial Training of 4 Weeks/5Weeks to be completed between the semester break**										
Programme Outcomes: PO_1 - PO_{12} **[ANNEXTURE-1]**							**Programme Specific Outcomes:** PSO_1 -PSO_4 **[ANNEXTURE-2]**			

Programme	Year	Semester (15 weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester)	Prerequisite	Elective (For other faculty)
	FOURTH YEAR	SEMESTER –VII	i) C21 (Th. 4 Cr. + P 2Cr.) ii) SEC-7 iii) Project Lab (Minor)	4 2 2 4	4 3 4 4	40 24 24 40	CAD/ CAM CAD/ CAM Lab MOOCS (SWAYAM/NPTEL) Minor Project *	5		
			i) SEC-8	2	2	24	Internship*			
			i) GE-2	4	4		***#To be opted from other department***			
		SEMESTER – VIII	i) GE-3 ii) DSE-4 iii) Major Project	4 4 10	4 4 20	 40 100	***#To be opted from other department*** Non-destructive Testing Flexible Manufacturing System Power Plant Engineering Automobile Engineering Major Project *			

***Minor and Major Project report will be evaluated by external & internal examiners.**
*** Industrial Training of 4 Weeks/5Weeks to be completed between the semester break**

Programme Outcomes:	**Programme Specific Outcomes:**
PO_1 - PO_{12} **[ANNEXTURE-1]**	PSO_1 -PSO_4 **[ANNEXTURE-2]**

ANNEXTURE-1

Program Outcomes:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and
Research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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ANNEXTURE-2

Program Specific Outcomes:

PSO1: Ability to recognize and examine the mechanical parts, machine apparatuses and systems and to get to know platforms, apparatuses, innovative work in the area of Mechanical Engineering.

PSO2: Apply the concepts of Mechanical Engineering and use AUTO CAD, Solid Works, and Ansys software for the design and development of industrial problems.

PSO3: Apply the knowledge of Mechanical Engineering in the various fields such as automobile industries, manufacturing units and power plants etc.

PSO4: Apply the principles and knowledge of Mechanical Engineering to analyze the most advanced system.

Format-3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Mathematical Thinking with Calculus and Linear Algebra**
Course Code: ENAS-111	**Title: Mathematical Thinking with Calculus and Linear Algebra**

Course Objectives:

1. To gain the knowledge of differential calculus required for the field of engineering.
2. To deal with functions of several variables that is essential in optimizing the results of real life problems.
3. To understand Multiple integral tools to deal with engineering problems involving Surface area, volume etc.
4. To deal with vector calculus that is required in different branches of Engineering to graduate engineers.
5. To understand the essential tools of matrices and linear algebra, Eigen values and diagonalization in a Comprehensive manner are required.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Differential Calculus:** Rolle's Theorem, Mean Value Theorems, Successive Differentiation (nth order derivatives), Leibnitz theorem, Taylor's and Maclaurin's Theorems (without proof), Expansion of functions (standard forms),	9L
II	**Partial Differentiation:** Functions of several variables, Limit, Continuity, Partial derivatives, Euler's Theorem, Total derivative, Chain rule, Jacobians, Taylor's expansion for multivariable functions, Maxima and Minima of functions of two variables.	9L
III	**Integral Calculus:** Multiple integration: Double integral, Triple integral, Change of order of integration, Change of variables, Application: Areas and volumes.	9L
IV	**Vector Calculus:** Vector differentiation: Gradient, Curl and Divergence and their Physical interpretation, Directional derivatives. Vector Integration: Line integral, Surface integral, Volume integral, Gauss's Divergence theorem, Green's theorem and Stoke's theorem (without proof) and their applications	9L

V	**Linear Algebra:** Types of Matrices: Symmetric, Skew-symmetric and Orthogonal Matrices; Complex Matrices, Inverse and Rank of matrix using elementary transformations, System of linear equations, Characteristic equation, Eigen values and eigenvectors, Cayley-Hamilton Theorem and its application, Diagonalization of a Matrix.	**9L**

Text Books:

1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*

Reference Books:

1. *E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.*
2. *Veerarajan T., Engineering Mathematics for first year, McGraw-Hill, New Delhi, 2008.*
3. *R K. Jain & S R K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House 2002*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	Understand the concept of differentiability and apply in the study of Successive differentiation, Leibnitz theorems and Partial differentiation.	**L2 & L3**
CO-2	Identify the application of partial differentiation and apply for evaluating maxima, minima, series and Jacobians.	**L3 &L4**
CO-3	Illustrate the working methods of multiple integral and apply for finding area, volume.	**L1& L3**
CO-4	Remember the concept of vector and apply for directional derivatives, tangent and normal planes. Also evaluate line, surface and volume integrals.	**L2 & L3**
CO-5	Remember the concept of matrices and apply for solving linear simultaneous equations.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	2	2	1	2	1	0	0	0	0	1	0
CO-3	2	2	0	1	1	0	0	0	0	0	0	2
CO-4	3	0	2	1	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I / II**
Credits: 4 **Theory: 4** **Practical: 2**	**Subject: Modern Physics in Engineering**
Course Code: ENAS-112/ENAS-122	**Title: Modern Physics in Engineering**

Course Objectives:

1. To know the concept of Interference and Diffraction.
2. To know the significance of Maxwell's equations in the Engineering applications of electromagnetic waves.
3. Explain Quantum Mechanics to understand wave particle dualism. Necessity of quantum mechanics to explore.
4. To understand the concept of Relativistic Mechanics.
5. To understand the Phenomenon of Fiber optics and Laser.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)
50% Marks / 2 Credits

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Wave Optics:** Interference: Basics of interference of light, coherent Sources, Conditions of Interference; Interference by division of wave front and amplitude (Interference due to thin film, Wedge shaped film and Newton's Rings). **Diffraction:** Fraunh offer Diffraction Due Single slit, Diffraction Grating; Diffraction due to N slits, Rayleigh's criterion of resolution; absent spectra, dispersive Power of grating, Resolving power of Grating.	**12L**
II	**Electromagnetic:** Gauss law Ampere's law and displacement current; Equation of continuity; Maxwell's equations in Integral and Differential Forms; Electromagnetic Wave Propagation in Free Space and Conducting Media; Poynting Theorem	**9L**
III	**Quantum Mechanics:** Planck's concept (hypothesis), Compton Effect, Particle properties of wave: Matter Waves, Davisson Germer Experiment, Heisenberg Uncertainty Principle, Wave function, and Schrodinger equation (time dependent & independent), Particle in a 1-D box.	**9L**
IV	**Relativistic Mechanics:** Inertial and Non- Inertial Frames; Michelson-Morley Experiment; Postulates of Special Theory of Relativity; Galilean	**9L**

	and Lorentz Transformation; Length Contraction and Time Dilation; Addition of Velocities; Mass Energy Equivalence and Variation of Mass with Velocity.	
V	**Laser:** Absorption of radiation, Spontaneous and stimulated emission of radiation, Population inversion, Einstein's Coefficients, Principles of laser action, Components of laser, Solid state Laser (Ruby laser) and Gas Laser (He-Ne laser), Laser applications	**6L**

Text Books:
1. Concepts of Modern Physics – Aurthur Beiser (Mc-Graw Hill)
2. Introduction to Special Theory of Relativity- Robert Resnick (Wiley)
3. Engineering Physics: Theory and Practical- Katiyar and Pandey (Wiley India)

Reference Books:
1. *Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New)*
2. *Engineering Physics-Malik HK and Singh AK (McGrawHill)*

If the course is available as **Generic Elective**, then the students of following departments may opt it: NO

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Physics of Class 12

Course Learning Outcomes:

CO-1	Apply the principles of wave optics to analyze and predict light behavior in various scenarios.	**L3 & L4**
CO-2	Analyze and solve problems involving electromagnetic fields and waves in various contexts.	**L4**
CO-3	Remember and apply the principles of quantum mechanics to understand and predict the behavior of particles at the atomic and subatomic levels.	**L1 & L3**
CO-4	Understand the principles of relativistic mechanics to analyze and predict the behavior of objects moving at velocities close to the speed of light.	**L2 & L4**
CO-5	Understand and apply the principles of laser technology.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1

CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B. Tech. ME**	**Year: I** **Semester: I/II**
Credits: 4 **Theory: 4** **Practical: 0**	**SUBJECT: ENGINEERING CHEMISTRY**
Course Code: ENAS-113/ ENAS-123	**Title: ENGINEERING CHEMISTRY**

Course Objectives:

1. To enable the students to understand about the Chemistry of Atomic and Molecular structure, Chemistry of advanced Materials like Liquid crystals, Nanomaterials, Graphite & fullerenes, and Green Chemistry.
2. To enable the students to understand and apply the detailed concepts of spectroscopic techniques and stereochemistry to identify the compounds, element etc.
3. To enable the students to understand and apply the concepts related to Electrochemistry, Batteries, Corrosion and Chemistry of Engineering Materials like cement.
4. To enable the students to understand and apply detailed concepts of water source, water impurities, hardness of water and boiler troubles used in industry as well as analysis of coal & determination of calorific values.
5. To enable the students to understand detailed concepts related to polymers, Polymerization, Polymer Blends, Polymer Composites, and organometallic compounds.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Atomic and Molecular Structure:** Molecular orbitals of diatomic molecules (bond order, magnetic characters and numerical problems). **Chemistry of Advanced Materials:** ***Liquid Crystals;*** Introduction, Types and Applications of liquid crystals, industrially important materials used as liquid crystals. ***Graphite and Fullerene;*** Introduction, Structure and applications. ***Nanomaterials;*** Introduction, Preparation, characteristics of nanomaterials and applications of nanomaterials: Carbon Nano Tubes (CNT) and graphene. **Green Chemistry:** Introduction to green chemistry, 12 principles and importance of green Synthesis, Green Chemicals, Synthesis of typical organic compounds by conventional and Green routes (Adipic acid and Paracetamol), Environmental impact of Green chemistry on society.	**10L**
II	**Spectroscopic techniques and Applications:** Elementary idea and	**8L**

	simple applications of Ultraviolet (UV) & Visible, fluorescence, Jablonski diagram, IR and Raman spectroscopy. **Stereochemistry:** Optical isomerism in compounds without chiral carbon, Geometrical isomerism, Chiral Drugs.	
III	**Electrochemistry:** Nernst Equation and application, relation of EMF with thermodynamic functions (ΔH, ΔF and Δ S). Lead storage battery. **Corrosion**; causes, effects and its prevention. **Chemistry of Engineering Materials:** ***Cement;*** Constituents, manufacturing, hardening and setting, deterioration of cement, Plaster of Paris (POP).	**9L**
IV	**Water Analysis:** Hardness of water, Techniques for water softening (Lime-soda, Zeolite, Ion exchange resin and Reverse osmosis method). **Fuels:** classification of fuels, Analysis of coal, Determination of calorific value (Bomb calorimeter and Dulon's method).	**8L**
V	**Polymers:** Basic concepts of Polymer-Blend and composites, Conducting and biodegradable polymers. Preparation and application of some industrially important polymers (Buna-S, Buna-N, Neoprene, Nylon-6, nylon-6,6, Teflon, Lucite, Bakelite, and Terylene). **Organometallic Compounds:** General methods of synthesis of organometallic compounds (Grignard reagent and lithium aluminum hydride) and their applications.	**9L**

Reference Books:

1. Engineering Chemistry by Rath & Singh, 2nd Edition, Cengage Learning India Pvt. Ltd Delhi.
2. Engineering Chemistry by SS Dara, S Chand & Co Ltd
3. Engineering Chemistry by Jain & Jain, S. Chand & Comp, New Delhi
4. Engineering Chemistry by K. Sesha Maheswaramma, Pearson
5. Engineering Chemistry by OG Palanna, Mc Graw Hill Education, New Delhi
6. Engineering Chemistry by Shashi Chawala, Dhanpat Rai Publishing Comp, New Delhi

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NA**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: NA

Course Learning Outcomes: After completion of the course, the student should be able to:

CO-1	Understand about the principles of atomic and molecular structure, bonding and properties, chemistry of advanced materials like Liquid Crystals, Nanomaterials, Graphite, graphene & Fullerenes as well as the principles of green chemistry.	**L1 & L2**

CO-2	Apply the fundamental concepts of determination of structure with various spectral techniques and stereochemistry	**L2 & L3**
CO-3	Apply the theory of construction of electrodes, batteries and fuel cells and re-designing or new engineering products, and categorize the reasons for corrosion and study methods to control corrosion, and develop an understanding of the chemistry of cement.	**L3 & L2**
CO-4	Understand the sources, impurities and hardness of water, apply the concepts of determination of calorific values and analyze the coal.	**L2, L3 & L4**
CO-5	Understand the chemical structure of polymers and its effect on their various properties when used as engineering materials. Understanding the applications of specific polymers and organometallic compounds, applicable in industrial process.	**L1 & L2**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	3	2	2	2	2	0	0	0	0	2
CO-2	2	3	2	3	3	1	1	0	0	0	0	2
CO-3	3	3	3	3	2	2	2	0	1	0	0	1
CO-4	3	3	3	2	2	2	2	0	0	0	0	1
CO-5	3	3	2	2	2	2	2	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**SUBJECT: FUNDAMENTALS OF MECHANICAL AND MECHATRONICS SYSTEMS**
Course Code: ENME-111N	**TITLE: FUNDAMENTALS OF MECHANICAL AND MECHATRONICS SYSTEMS**

Course Objectives:

1. Introduce fundamental principles and theories in Mechanical Engineering.
2. Provide an overview of the historical development and current trends in Mechanical Engineering.
3. Familiarize students with basic engineering concepts such as forces, materials, structures, and systems relevant to both disciplines.
4. Develop problem-solving skills through practical applications and case studies in Mechanical Engineering contexts.
5. Cultivate an understanding of the interdisciplinary nature of Engineering and its impact on society and the environment.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Materials:** Classification of engineering material, Composition of Cast iron and Carbon steels, Iron Carbon diagram. Mechanical properties like strength, hardness, toughness, ductility, brittleness, malleability etc. of materials. Hooks law and modulus of elasticity, Hardness and Impact testing of materials, BHN etc.	9L
II	**Force Systems**: Basic concepts: Definitions, Basic assumptions, Scalar & Vector quantities, Classification of forces & Representation, Force as a Vector, Composition of forces, Parallelogram Law, Resolution, Principle of Transmissibility of forces **Coplanar Concurrent Force system and Coplanar:** Equilibrium of coplanar force system, Free body diagrams, Determination of reactions, Equilibrium of a body under three forces, Lami's theorem.	9L

III	**Introduction to mechanics of solid:** Normal and shear Stress, strain, Hookes' law, Poisson's ratio, elastic constants and their relationship, stress-strain diagram for ductile and brittle materials, factor of safety. Basic Numerical problems. Types of beams under various loads.	**9L**
IV	**Thermodynamics:** Thermodynamic system, properties, state, process, Zeroth, First and second law of thermodynamics, thermodynamic processes at constant pressure, volume, enthalpy & entropy. Steam Engineering: Classification and working of boilers, mountings and accessories of boilers, Efficiency.	**9L**
V	**Fundamental of Mechatronics:** Definition of Mechatronics, Sensors and Transducers: Definition, difference, classification, Actuators: Definition and Classification of Actuators Need and Scope, Programmable Logic Controller (PLC): Definition, PLC block diagram, Microcontroller: Comparison of Microprocessor and Microcontroller	**9L**

Text Books:
1. Nag P.K, Engineering Thermodynamics, TMH.
2. Agrawal C M, Basic Mechanical Engineering, Wiley Publication.

Reference Books:
1. Nag P.K, Engineering Thermodynamics, TMH.
2. Achuthan M, Engineering Thermodynamics, PHI. List of Suggestive
3. Ganesan, Internal Combustion Engines, TMH.
4. Textbook Of Mechatronics. R K Rajput

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand mechanical properties such as strength, hardness, toughness, ductility, brittleness, and malleability.	**L2 & L3**
CO-2	Understand the working principles of Lamis theorem	**L3 &L4**
CO-3	Understand steam engineering principles including boiler classification, mountings, accessories, and efficiency.	**L1& L3**
CO-4	Understand the concepts and purposes of various forces.	**L2 & L3**

CO-5	Understand about the basics of Mechatronics.	L2& L4

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Structured Programming and Problem Solving in C**
Course Code: ENCS-111	**Title: Structured Programming and Problem Solving in C**

Course Objectives:

1. To understand the basics of computers, programming languages, the history and structure of the C language, and its compilation and execution process.
2. To learn to define problems, analyze them, and create solutions using algorithms, flowcharts, and pseudo code.
3. To gain proficiency in data types, variables, constants, literals, operators, expressions, and input/output functions in C.
4. To apply conditional statements, switch-case statements, looping structures, and functions, including recursion and library functions, in C programs.
5. To Work with arrays, strings, pointers, structures, unions, file handling, preprocessor directives, and advanced data structures, and solve real-world problems through case studies and project-based learning.

Nature of Paper: VAC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION TO PROGRAMMING AND PROBLEM SOLVING:** **INTRODUCTION TO COMPUTERS AND PROGRAMMING:** Overview of computers and programming languages, History and evolution of C language, Basic structure of a C program, Compilation and execution process. **PROBLEM SOLVING TECHNIQUES:** Problem definition and analysis, Algorithms and flowcharts, Pseudocode **FUNDAMENTALS OF C:** Data types and variables, Constants and literals, Operators and expressions, Input and output functions.	**9L**
II	**CONTROL STRUCTURES AND FUNCTIONS:** **CONTROL STRUCTURES:** Conditional statements (if, if-else, nested if), Switch-case statements, looping structures (for, while, do-while), Break and continue statements, **FUNCTIONS:** Function declaration and definition, Function calling and	**9L**

	parameter passing, Scope and lifetime of variables, Recursive functions, Library functions.	
III	**ARRAYS, STRINGS, AND POINTERS:** **ARRAYS:** One-dimensional arrays, Two-dimensional arrays, Multidimensional arrays, Array operations and applications, **STRINGS:** String handling functions, String manipulation techniques. **POINTERS:** Introduction to pointers, Pointer arithmetic, Pointers and arrays, Pointers to functions, Dynamic memory allocation.	**9L**
IV	**STRUCTURES, UNIONS, AND FILE HANDLING:** **STRUCTURES AND UNIONS:** Defining and declaring structures, Accessing structure members, Array of structures, Nested structures, Unions and their applications. **FILE HANDLING:** File operations (opening, closing, reading and writing), File modes, Sequential and random access files, Error handling in file operations.	**9L**
V	**ADVANCED TOPICS AND CASE STUDIES:** **PREPROCESSOR DIRECTIVES:** Macros, File inclusion, Conditional compilation. **ADVANCED DATA STRUCTURES:** Introduction to linked lists, Stacks and queues (concepts and basic operations). **PROBLEM SOLVING CASE STUDIES:** Real-world problem solving using C, Case studies and project-based learning, Debugging and testing techniques, Best practices in programming.	**9L**

Text Books:

1. *Computer Programming with C, Special Edition-MRCET, Mc Graw Hill Publishers 2017,*
2. *Computer Science: A Structured Programming Approach Using C, B, A, Forouzan and R, F, Gilberg, Third Edition, Cengage Learning,*

Reference Books:

1. *The C Programming Language, B, W, Kernighan and Dennis M, Ritchie, PHI*
2. *Computer Programming, E, Balagurusamy, First Edition, TMH*
3. *C and Data structures – P, Padmanabham, Third Edition, B, S, Publications,*

If the course is available as **Generic Elective**, then the students of following departments may opt it: NO

Evaluation/Assessment Methodology	
Category	**Max, Marks**
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Students will demonstrate an understanding of the fundamentals of computers, and evolution of the C programming language, the basic structure of a C program, and the compilation and execution processes.	**L2 & L3**
CO-2	Students will be able to define and analyze programming problems, develop algorithms, create flowcharts, and write pseudo code to design effective solutions.	**L1,L2& L3**
CO-3	Students will gain proficiency in fundamentals of C and will be able to implement basic input and output functions.	**L1,L2& L3**
CO-4	Students will be able to apply conditional statements, switch-case statements, and looping structures to control program flow, and will understand function declaration, definition, calling, parameter passing, scope, lifetime of variables, and recursion.	**L2,L3 & L4**
CO-5	Students will demonstrate the ability to work with arrays, strings, and pointers, define and utilize structures and unions, perform file operations, and understand advanced data structures like linked lists, stacks, and queues. They will also be able to solve real-world problems using C.	**L2,L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	2	3	1	2	2	1	0	0	0	1	2	3
CO-2	3	2	3	2	1	1	0	0	0	1	1	1
CO-3	3	2	2	2	1	0	0	0	0	0	1	3
CO-4	2	3	3	2	2	1	0	0	0	1	2	2
CO-5	1	3	2	3	2	1	0	0	0	0	1	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I/II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Professional Communication and Digital fluency**
Course Code: ENAS-114/ ENAS-124	**Title: Professional Communication and Digital fluency**

Course Objectives:

1. To understand and apply basic principles of professional communication, including the communication process and overcoming barriers.
2. To enhance the essentials of technical writing for engineering, including reports, documentation, professional emails, and proposals.
3. To gain confidence in public speaking, create effective presentations, and learn to engage different audiences.
4. To develop skills for building rapport, effective teamwork, conflict resolution, and leadership communication.
5. To learn to effectively use digital communication tools, social media, and adapt to emerging trends in global engineering contexts.

Nature of Paper: AECC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Fundamentals of Communication:** Definition and importance, Communication process, Verbal and non-verbal communication, Barriers to communication, Formal and informal communication.	9L
II	**Professional Speaking and Presentation Skills:** Public speaking, Group discussion, Effective oral communication, Use of visual aids, Body language, Elevator pitch, Presentation planning and delivery.	9L
III	**Business and Technical Writing:** Email etiquette, Resume and cover letter writing, Report writing, Technical documentation, Memos, Minutes of meetings.	9L
IV	**Digital Literacy and Collaboration Tools:** Digital platforms for communication (Zoom,Teams, Slack), Cloud collaboration (Google Docs, OneDrive), Etiquette of digital communication, Netiquette, Cyber safety.	9L
V	**Professionalism and Work Ethics:** Workplace behavior, Teamwork, Leadership communication, Conflict resolution, Time management, Building	9L

	online presence through LinkedIn and digital portfolios.	

Text Books and Reference Books:

1. *"Technical Communication: A Practical Approach" by William Sanborn Pfeiffer and Kaye E. Adkins*
2. *"The Essentials of Technical Communication" by Elizabeth Tebeaux and Sam Dragga*
3. *"Engineering Communication" by Charles W. Knisely and Karin I. Knisely*
4. *"Communicating in Groups: Applications and Skills" by Katherine Adams, Gloria Galanes, and Brandi R. Fritz*
5. *"Digital Communications: Fundamentals and Applications" by Bernard Sklar*

If the course is available as **Generic Elective**, then the students of following departments may opt it: NO

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations/Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: English of Class 12

Course Learning Outcomes:

CO-1	Demonstrate effective communication skills, including verbal, non-verbal, and written, in professional engineering contexts.	**L2 & L3**
CO-2	Develop clear, concise, and coherent technical documents, including reports, project documentation, and professional emails.	**L3 &L4**
CO-3	Deliver engaging and informative oral presentations tailored to diverse audiences, utilizing effective visual aids and presentation techniques.	**L1& L3**
CO-4	Exhibit strong interpersonal and teamwork skills, including active listening, conflict resolution, and leadership communication.	**L2 & L3**
CO-5	Utilize digital communication tools and social media platforms to enhance professional networking and collaboration, adapting to emerging communication trends and global engineering contexts.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1

CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I/II**
Credits: 5 **Theory: 4** **Practical: 1**	**SUBJECT: ENVIRONMENT, ECOLOGY AND SUSTAINIBILITY**
Course Code: ENHU-112/ ENHU-122P	**TITLE: ENVIRONMENT, ECOLOGY AND SUSTAINIBILITY**

Course Objectives:

1. To introduce students to the interrelationship between humans and the environment, tracing historical, cultural, and ethical dimensions of sustainability.
2. To equip students with knowledge about natural resources, biodiversity, ecosystems, and their conservation strategies.
3. To raise awareness of major environmental issues local to global—such as pollution, climate change, land degradation, and disaster risk.
4. To familiarize students with environmental laws, policies, and international treaties related to environmental governance and sustainable development.
5. To encourage experiential learning through field visits, case studies, and hands-on campus environmental management activities.

Nature of Paper: AECC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)
50% Marks / 1 Credits

L : 3	T : 1	P : 3	C : 4+1

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Humans and the Environment:** The man-environment interaction: Humans as hunter-gatherers; Mastery of fire; Origin of agriculture; Emergence of city-states; Great ancient civilizations and the environment, Indic Knowledge and Culture of sustainability; Middle Ages and Renaissance; Industrial revolution and its impact on the environment; Population growth and natural resource exploitation; Global environmental change. **Environmental Ethics and emergence of environmental ism**: Anthropocentric and eco-centric perspectives (Major thinkers); The Club of Rome- Limits to Growth; UN Conference on Human Environment 1972; World Commission on Environment and Development and the concept of sustainable development; Rio Summit and subsequent international efforts.	9L
II	**Natural Resources and Sustainable Development**: Overview of natural resources: Definition of resource; Classification of natural resources- biotic and abiotic, renewable and non-renewable.	9L

	Biotic resources: Major type of biotic resources- forests, grasslands, wetlands, wildlife and aquatic (fresh water and marine); Microbes as a resource; Status and challenges. **Water resources**: Types of water resources- fresh water and marine resources; Availability and use of water resources; Environmental impact of over-exploitation, issues and challenges; Water scarcity and stress; Conflicts over water. **Soil and mineral resources**: Important minerals; Mineral exploitation; Environmental problems due to extraction of minerals and use; Soil as a resource and its degradation. **Energy resources**: Sources of energy and their classification, renewable and non-renewable sources of energy; Conventional energy sources- coal, oil, natural gas, nuclear energy; Non-conventional energy sources- solar, wind, tidal, hydro, wave, ocean thermal, geothermal, biomass, hydrogen and fuel cells; Implications of energy use on the environment. **Introduction to sustainable development**: Sustainable Development Goals (SDGs) - targets and indicators, challenges and strategies for SDGs.	
III	**Environmental Issues: Local, Regional and Global:** **Environmental issues and scales**: Concepts of micro-, meso-, synoptic and planetary scales; Temporal and spatial extents of local, regional, and global phenomena. **Pollution**: Impact of sectoral processes on Environment; Types of Pollution- air, noise, water, soil, thermal, radioactive; municipal solid waste, hazardous waste; transboundary air pollution; acid rain; smog. Land use and Land cover change: land degradation, deforestation, desertification, urbanization. Biodiversity loss: past and current trends, impact. **Global change**: Ozone layer depletion; Climate change. Disasters – Natural and Man-made	**9L**
IV	**Conservation of Biodiversity and Ecosystems:** Biodiversity and its distribution: Biodiversity as a natural resource; Levels and types of biodiversity; Biodiversity in India and the world; Biodiversity hotspots; Species and ecosystem threat categories. **Ecosystems and ecosystem services**: Major ecosystem types in India and their basic characteristics- forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services- classification and their significance. Threats to biodiversity and ecosystems: Land use and land cover change; Commercial exploitation of species; Invasive species; Fire, disasters and climate change. **Major conservation policies**: in-situ and ex-situ conservation approaches; Major protected areas; National and International Instruments for biodiversity conservation; the role of traditional knowledge, community-based conservation; Gender and conservation.	**9L**
V	Environmental Pollution and Health: Understanding pollution: Production processes and generation of wastes; Assimilative capacity of the environment; Definition of pollution; Point sources and non-point sources of pollution. Air pollution: Sources of air pollution; Primary and secondary pollutants;	**9L**

	Criteria pollutants- carbon monoxide, lead, nitrogen oxides, ground-level ozone, particulate matter and sulphur dioxide; Other important air pollutants- Volatile Organic compounds (VOCs), Peroxyacetyl Nitrate (PAN), Polycyclic aromatic hydrocarbons (PAHs) and Persistent organic pollutants (POPs); Indoor air pollution; Adverse health impacts of air pollutants; National Ambient Air Quality Standards. Water pollution: Sources of water pollution; River, lake and marine pollution, groundwater pollution; water quality Water quality parameters and standards; adverse health impacts of water pollution on human and aquatic life. Soil pollution and solid waste: Soil pollutants and their sources; Solid and hazardous waste; Impact on human health. Noise pollution: Definition of noise; Unit of measurement of noise pollution; Sources of noise pollution; Noise standards; adverse impacts of noise on human health. Thermal and Radioactive pollution: Sources and impact on human health and ecosystems.	
VI	Climate Change: Impacts, Adaptation and Mitigation: Understanding climate change: Natural variations in climate; Structure of atmosphere; Anthropogenic climate change from greenhouse gas emissions– past, present and future; Projections of global climate change with special reference to temperature, rainfall, climate variability and extreme events; Importance of 1.5 °C and 2.0 °C limits to global warming; Climate change projections for the Indian sub-continent. Impacts, vulnerability and adaptation to climate change: Observed impacts of climate change on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests and natural ecosystems; Impacts on animal species, agriculture, health, urban infrastructure; the concept of vulnerability and its assessment; Adaptation vs. resilience; Climate-resilient development; Indigenous knowledge for adaptation to climate change. **Mitigation of climate change**: Synergies between adaptation and mitigation measures; Green House Gas (GHG) reduction vs. sink enhancement; Concept of carbon intensity, energy intensity and carbon neutrality; National and international policy instruments for mitigation, decarbonizing pathways and net zero targets for the future; Energy efficiency measures; Renewable energy sources; Carbon capture and storage, National climate action plan and Intended Nationally Determined Contributions (INDCs); Climate justice.	**9L**

VII	Environmental Management: Introduction to environmental laws and regulation: Constitutional provisions- Article 48A, Article 51A (g) and other derived environmental rights; Introduction to environmental legislations on the forest, wildlife and pollution control. Environmental management system: ISO 14001 Concept of Circular Economy, Life cycle analysis; Cost-benefit analysis Environmental audit and impact assessment; Environmental risk assessment Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability; Ecolabeling/Ecomark scheme	**9L**
VIII	**Environmental Treaties and Legislation**: An overview of instruments of international cooperation; bilateral and multilateral agreements; conventions and protocols; adoption, signature, ratification and entry into force; binding and non- binding measures; Conference of the Parties (COP) **Major International Environmental Agreements**: Convention on Biological Diversity (CBD); Cartagena Protocol on Biosafety; Nagoya Protocol on Access and Benefit-sharing; **Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES);** Ramsar Convention on Wetlands of International Importance; United Nations Convention to Combat Desertification (UNCCD); Vienna Convention for the Protection of the Ozone Layer; Montreal Protocol on Substances that Deplete the Ozone Layer and the Kigali Amendment; Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal; Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade; Stockholm Convention on Persistent Organic Pollutants; Minamata Convention on Mercury; United Nations Framework Convention on Climate Change (UNFCCC); Kyoto Protocol; Paris Agreement; India's status as a party to major conventions **Major Indian Environmental Legislations**: The Wild Life (Protection) Act, 1972; The Water (Prevention and Control of Pollution) Act, 1974; The Forest (Conservation) Act, 1980; The Air (Prevention and Control of Pollution) Act, 1981; The Environment (Protection) Act, 1986; The Biological Diversity Act, 2002; The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006; Noise Pollution (Regulation and Control) Rules, 2000; Industry-specific environmental standards; Waste management rules; Ramsar sites; Biosphere reserves; Protected Areas; Ecologically Sensitive Areas; Coastal Regulation Zone; Status phase-out of production and consumption of Ozone Depleting Substances by India; National Green Tribunal; Some landmark Supreme Court judgements **Major International organizations and initiatives**: United Nations Environment Programme (UNEP), International Union for Conservation of Nature (IUCN), World Commission on Environment and Development (WCED), United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Panel on Climate Change (IPCC), and Man and the Biosphere (MAB) programme.	**9L**

IX	**Case Studies and Field Work**: The students are expected to be engaged in some of the following or similar identified activities: 1. Discussion on one national and one international case study related to the environment and sustainable development. 2. Field visits to identify local/regional environmental issues, make observations including data collection and prepa re a brief report. 3. Participation in plantation drive and nature camps. 4. Documentation of campus biodiversity. Campus environmental management activities such as solid waste disposal, water Management and sanitation, and sewage treatment.	**9L**

Reference Books: Reference Books:

1. Fisher, Michael H. (2018) An Environmental History of India- From Earliest Times to the Twenty-First Century, Cambridge University Press.
2. Hedrick, Daniel R. (2020) Humans versus Nature- A Global Environmental History, Oxford University Press.
3. Hughes, J. Donald (2009) An Environmental History of the World- Humankind's Changing Role in the Community of Life, 2nd Edition. Routledge.
4. Perman, R., Ma, Y., McGillivray, J., and Common, M. (2003) Natural Resource and Environmental Economics. Pearson Education.
5. Simmons, I. G. (2008). Global Environmental History: 10,000 BC to AD 2000. Edinburgh University Press
6. Chiras, D. D and Reganold, J. P. (2010). Natural Resource Conservation: Management for a Sustainable Future.10th edition, Upper Saddle River, N. J. Benjamin/Cummins/Pearson.
7. John W. Twidell and Anthony D. (2015). Renewable Energy Sources, 3rd Edition, Weir Publisher (ELBS)
8. William P.Cunningham and Mary A. (2015) Cunningham Environmental Science: A Global Concern, Publisher (Mc-Graw Hill, USA)
9. Gilbert M. Masters and W. P. (2008). An Introduction to Environmental Engineering and Science, Ela Publisher (Pearson)
10. Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications https://sdgs.un.org/goals
11. Harper, Charles L. (2017) Environment and Society, Human Perspectives on Environmental Issues 6th Edition. Routledge.
12. Harris, Frances (2012) Global Environmental Issues, 2nd Edition. Wiley- Blackwell.
13. William P. Cunningham and Mary A. (2015). Cunningham Environmental Science: A global concern, Publisher (Mc-Graw Hill, USA)
14. Manahan, S.E. (2022). Environmental Chemistry (11^{th} ed.). CRC Press. https://doi. org/10.1201/9781003096238
15. Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press.
16. Bawa, K.S., Oomen, M.A. and Primack, R. (2011) Conservation Biology: A Primer for South Asia. Universities Press.
17. Sinha, N. (2020) Wild and Wilful. Harper Collins, India.
18. Varghese, Anita, Oommen, Meera Anna, Paul, Mridula Mary, Nath, Snehlata (Editors) (2022) Conservation through Sustainable Use: Lessons from India. Routledge.
19. Bhagwat, Shonil (Editor) (2018) Conservation and Development in India: Reimagining Wilderness, Earthscan Conservation and Development, Routledge.

20. Krishnamurthy, K.V. (2003) Textbook of Biodiversity, Science Publishers, Plymouth, UK
21. Jackson, A. R., & Jackson, J. M. (2000). Environmental Science: The Natural Environment and Human Impact. Pearson Education.
22. Masters, G. M., & Ela, W. P. (2008). *Introduction to environmental engineering and science* (No. 60457). Englewood Cliffs, NJ: Prentice Hall.
23. Miller, G. T., & Spoolman, S. (2015) Environmental Science. Cengage Learning.
24. Central Pollution Control Board Web page for various pollution standards. https://cpcb.nic.in/standards/
25. Ahluwalia, V. K. (2015). *Environmental Pollution, and Health*. The Energy and Resources Institute (TERI).
26. Pittock, Barrie (2009) Climate Change: The Science, Impacts and Solutions. 2nd Edition. Routledge.
27. www.ipcc.org; https://www.ipcc.ch/report/sixth-assessment-report-cycle/.
28. Adenle A., Azadi H., Arbiol J. (2015). Global assessment of technological innovation for climate change adaptation and mitigation in developing world, Journal of Environmental Management, 161 (15): 261-275.
29. Barnett, J. & S. O'Neill (2010). Maladaptation. Global Environmental Change—Human and Policy Dimensions 20: 211–213.
30. Berrang-Ford, L., J.D. Ford & J. Paterson (2011). Are we adapting to climate change? Global Environmental Change—Human and Policy Dimensions 21: 25-33.
31. Jørgensen, Sven Marques, Erik João Carlos and Nielsen, Søren Nors (2016) Integrated Environmental Management, A trans disciplinary Approach. CRC Press.
32. Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.
33. Barrow, C. J. (1999). Environmental management: Principles and practice. Routledge.
34. Tiefenbacher, J (ed.) (2022), Environmental Management - Pollution, Habitat, Ecology, and Sustainability, Intech Open, London. 10.5772/
35. Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.
36. UNEP (2007) Multilateral Environmental Agreement Negotiator's Handbook, University of Joensuu, ISBN 978-952-458-992-5
37. Ministry of Environment, Forest and Climate Change (2019) A Handbook on International Environment Conventions & Programmes. https://moef.gov.in/wp- content/uploads/2020/02/convention-V-16-CURVE-web.pdf
38. Kanchi Kohli and Manju Menon (2021) Development of Environment Laws in India, Cambridge University Press.
39. India Code – Digital repository of all Central and State Acts: https://www.indiacode.nic.in/Bohra, Saroj, Judicial Intervention and Evolution of Environmental Principles and Doctrines (January 7, 2019). Available at SSRN: https://ssrn.com/abstract=3311406 or http://dx.doi.org/10.2139/ssrn.3311406

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA

3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Course Learning Outcomes:

CO1	Explain the evolution of human-environment interaction, environmental ethics, and sustainability principles.	L2
CO2	Classify natural resources and evaluate their usage, challenges, and conservation strategies.	L3
CO3	Analyze local, regional, and global environmental issues, including pollution, biodiversity loss, and land use change.	L4
CO4	Interpret the causes, consequences, and mitigation strategies of climate change and global environmental change.	L3
CO5	Describe key environmental policies, laws, and treaties at national and international levels.	L2

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO1	2	1	1	1	1	2	3	2	1	2	0	2
CO2	2	2	2	2	1	2	3	2	0	1	0	3
CO3	1	2	2	2	1	3	3	2	1	2	0	3
CO4	2	2	2	2	2	3	3	2	1	2	0	3
CO5	2	1	1	1	1	3	3	3	0	2	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I/II**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: MODERN PHYSICS IN ENGINEERING LAB**
Course Code: ENAS-112P/ ENAS-122P	**Title: MODERN PHYSICS IN ENGINEERING LAB**

Course Objectives:
1. To understand the concept of wave length by the interference
2. To understand the concept of wave length by the diffraction.
3. To understand the concept of viscosity of liquid and flow of liquid
4. To understand the energy band gap in the semiconductors
5. To understand the concept of polarization

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	To determine the wavelength of Sodium light by Newton's rings
Practical-2.	To determine the wavelength of prominent lines of mercury by plane diffraction grating
Practical-3.	To determine the focus length combination of two lenses separated by distance and verify the formula for the focal length of combination of lenses
Practical-4.	To determine the wave length of sodium light with the help of Fresnel's bi-prism
Practical-5.	To determine the coefficient of viscosity of a given liquid
Practical-6.	To verify Stefan's law
Practical-7.	Calibration of a volt meter with potentiometer
Practical-8.	To determine the resistance per unit length and specific resistance of a given resistance using Carey Foster 's Bridge
Practical-9.	To determine the energy bend gap of a given semiconductor material
Practical-10.	To determine the Specific Rotation of the Cane sugar solution with the help of Polarimeter

Reference/Text Books:
1. *Practical Physics- K. K. Dey & B. N. Dutta (Kalyani Publishers New Delhi)*
2. *Engineering Physics- Practical- Katiyar & Pandey (Wiley India)*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce (External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	To determine the wavelength of sodium light by Newton's ring experiment	**L3**
CO-2	To determine the wavelength of sodium light with the help of Fresnel's bi-prism	**L3**
CO-3	To determine the viscosity of liquid.	**L3**
CO-4	To determine the emission of energy with respect the temperature and verify Stefan's law.	**L3 & L4**
CO-5	To determine the calibration of potential and draw the curve.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	2	0	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	2	2	1	0	0	0	0	0	0	2	2
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I & II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: Engineering Chemistry Lab**
Course Code: ENAS-113P/ ENAS-123P	**Title: Engineering Chemistry Lab**

Course Objectives:
1. Student will be able to Estimate different impurities present in water sample.
2. Student will be able to Determine molecular properties such as surface tension, viscosity, pH, conductance and concentration of solution.
3. Student will be able to Identify iron concentration and percentage of available chlorine in supplied sample using titration methods

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	To determine total alkalinity in the given water sample.
Practical-2.	To determine the temporary and permanent hardness in water sample using EDTA as standard solution.
Practical-3.	To determine the available chlorine in bleaching powder solution.
Practical-4.	To determine the chloride content in the given water sample by Mohr's method.
Practical-5.	To determine the pH of the given solution using pH meter and pH-metric titration.
Practical-6.	To determine the Equivalent weight of Iron by the chemical displacement method.
Practical-7.	To determine the Viscosity of an addition polymer like polyester by Viscometer.
Practical-8.	To find chemical oxygen demand of waste water sample by potassium dichromate
Practical-9.	To determine the iron content in the given sample using external indicator
Practical-10.	To determine the strength of given HCL solution by titrating against N/10 Standard Sodium hydroxide solution

Reference/Text Books:
1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks

1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce (External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Estimate different impurities present in water sample.	**L4**
CO-2	Determine molecular properties such as surface tension, viscosity, pH, conductance and concentration of solution	**L3**
CO-3	Identify iron concentration and percentage of available chlorine in supplied sample using titration methods.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	0	2	1	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	3	3	1	0	0	0	0	0	0	2	1
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I & II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: PROGRAMMING WITH C LAB: HANDS ON LOGIC BUILDING**
Course Code: ENCS-111P	**Title: PROGRAMMING WITH C LAB: HANDS ON LOGIC BUILDING**

Course Objectives:

1. To develop proficiency in implementing fundamental programming constructs such as loops, conditionals, functions, and arrays in C language through hands-on lab exercises.
2. To Gain practical experience in implementing and using data structures like arrays, linked lists, stacks, and queues to solve programming problems during lab sessions.
3. To Enhance problem-solving skills by applying algorithms learned in theory to practical programming tasks.
4. To engage in project-based learning activities where students work in teams to tackle larger programming projects.
5. To acquire skills in debugging and error handling techniques by identifying and resolving common programming errors encountered during lab exercises, ensuring robust and error-free code.

Nature of Paper: VAC (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Develop a program that performs basic arithmetic operations (addition, subtraction, multiplication, division) based on user input.
Practical-2.	Create a program to convert temperatures between Celsius, Fahrenheit, and Kelvin.
Practical-3.	Build a basic ATM simulation that allows users to check balance, deposit, and withdraw money.
Practical-4.	Develop a program to simulate a simple voting system with options and tallying votes.
Practical-5.	Create a program to calculate student grades based on user input of marks.
Practical-6.	Write a program that identifies whether a number is odd or even.
Practical-7.	Develop a program to check if a given year is a leap year.
Practical-8.	Create a program to solve quadratic equations.
Practical-9.	Implement a menu-driven program that performs different tasks like calculating area,

	volume, etc., based on user choice.
Practical-10.	Develop a recursive function to compute the factorial of a number.
Practical-11.	Develop a program to store and manipulate student marks using arrays. Calculate average, highest, and lowest marks.
Practical-12.	Implement a program to perform multiplication of two matrices.
Practical-13.	Create a function to reverse a string without using library functions.
Practical-14.	Write a program to dynamically allocate memory for an array and perform operations on it (e.g., finding the maximum element).
Practical-15.	Implement linear and binary search algorithms to find an element in an array
Practical-16.	Develop a program to check if a given string is a palindrome.
Practical-17.	Create a function that swaps two variables using pointers.
Practical-18.	Write a program to count the frequency of each character in a string.
Practical-19.	Develop a program to dynamically resize an array as elements are added or removed.
Practical-20.	Implement a function to concatenate two strings without using library functions.
Practical-21.	Create a program to manage employee records using structures.
Practical-22.	Implement a program to store and retrieve student details using file handling.
Practical-23.	Write a program to copy contents from one file to another.
Practical-24.	Create a payroll system that calculates and displays employee salaries, storing the data in files.
Practical-25.	Implement an inventory management system to track products using structures and file handling.
Practical-26.	Develop a program to manage patient records using structures and files.
Practical-27.	Create a program to demonstrate file error handling techniques.
Practical-28.	Write a program to generate student grade reports and save them in a file.
Practical-29.	Implement a singly linked list with operations like insertion, deletion, and traversal.
Practical-30.	Create a program to implement stack operations using arrays and linked lists.
Practical-31.	Develop a program to simulate a queue using arrays and linked lists.
Practical-32.	Write a program to count the number of words in a text file.
Practical-33.	Implement a program using macros for basic arithmetic calculations.
Practical-34.	Develop a program to recursively list all files in a directory (if operating system access is allowed).
Practical-35.	Implement a basic Sudoku solver using backtracking and recursion.
Practical-36.	Develop a comprehensive project simulating bank transactions including account creation, deposit, withdrawal, and balance inquiry, integrating structures, file handling, and dynamic memory allocation.

Text Books:

1. *Computer Programming with C, Special Edition-MRCET, Mc Graw Hill Publishers 2017,*
2. *Computer Science: A Structured Programming Approach Using C, B, A, Forouzan and R, F,*

Gilberg, Third Edition, Cengage Learning,

Reference Books:

1. *The C Programming Language, B, W, Kernighan and Dennis M, Ritchie, PHI*
2. *Computer Programming, E, Balagurusamy, First Edition, TMH*
3. *C and Data structures – P, Padmanabham, Third Edition, B, S, Publications,*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Able to develop programs that perform fundamental arithmetic operations	**L2 & L3**
CO-2	Ale to use arrays, pointers, and structures by creating programs for matrix multiplication, student mark storage, employee records management, and dynamically resizing arrays	**L3 &L4**
CO-3	Able to implement recursive functions, linear and binary search algorithms	**L1& L3**
CO-4	will learn to manage data using file handling techniques, including storing and retrieving student details, copying file contents, generating grade reports, and handling file errors, essential for real-world applications	**L2 & L3**
CO-5	will apply their theoretical knowledge to practical, real-life scenarios, integrating multiple programming concepts seamlessly	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	1	0	0	0	1	2	3
CO-2	3	3	3	2	1	1	0	0	0	1	1	3
CO-3	3	3	3	3	1	0	0	0	0	0	1	3
CO-4	3	3	3	2	21	1	0	0	0	1	2	3
CO-5	3	3	3	3	2	1	0	0	0	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I/II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: PROFESSIONAL COMMUNICATION LAB**
Course Code: ENAS-114P/ ENAS-124P	**Title: PROFESSIONAL COMMUNICATION LAB**

Course Objectives:

1. To enhance students' ability to communicate effectively in social and professional settings
2. To focus on the correct pronunciation and intonation patterns of English to ensure clear and understandable speech
3. To provide a solid foundation in English grammar and expand vocabulary for more accurate and expressive language use
4. To develop active listening skills and improve comprehension abilities through focused practice and exercises
5. To equip students with essential soft skills such as interview handling, email etiquette, and presentation skills to succeed in professional environments.

Nature of Paper: AECC (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0	T: 0	P: 2	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title(English-Wordsworth-Language Lab)
Module-1.	**Communication Skills –** 1. Social Meeting People & Asking Questions 2. Making Friends 3. Dos & Don'ts 4. What do you do?
Module-2.	**English Concepts –** 1. Tenses 2. Parts of Speech 3. Figures of Speech 4. Direct & Indirect Speech
Module-3.	**Pronunciation –** 1. Phonetics & Intonations 2. Vowels, Consonants, Nouns
Module-4.	**Communication Skills –** 1. Listening Skills 2. Speaking Skills

	3. Reading Skills 4. Writing Skills
Module-5.	**Advance Learning & Soft Skills –** 1. Effective Communication 2. Interview Handling Skills 3. Email Etiquette 4. Presentation Skills 5. Listening Comprehension

Text Books/Reference Books:

1. *Daniel Jones: English Pronouncing Dictionary*
2. *R.K. Bansal: Phonetics in English*
3. *Sethi and Dhamija: A Course in English Phonetics*
4. *S.D. Sharma: A Text-Book of Professional Communication & ESP*
5. *S.D. Sharma: Manual on Communication Lab English*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Students will demonstrate improved ability to meet and engage with people, make friends, and handle social interactions confidently and appropriately	**L2 & L3**
CO-2	Students will exhibit correct pronunciation, intonation, and the ability to articulate vowels, consonants, and nouns clearly	**L3 &L4**
CO-3	Students will show proficiency in using tenses, parts of speech, and figures of speech in both written and spoken English	**L1& L3**
CO-4	Students will display heightened listening skills and the ability to comprehend and respond accurately to spoken and written English	**L1 & L4**
CO-5	Students will be able to effectively manage interviews, compose professional emails, and deliver impactful presentations, showcasing their preparedness for professional scenarios	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	1	0	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	2	2	1	0	0	0	0	1	2
CO-3	0	2	2	2	1	0	0	0	0	0	1	2
CO-4	1	3	2	2	2	0	0	0	0	0	1	1
CO-5	1	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: ELECTRONICS IN THE MODERN WORLD LAB**
Course Code: ENEE-121P	**Title: ELECTRONICS IN THE MODERN WORLD LAB**

Course Objectives:
1. To analyze a given network by applying various electrical laws.
2. To analyze a given network by applying various electrical network theorems
3. To know the response of electrical circuits for different excitations
4. To calculate, measure and know the relation between basic electrical parameters
5. To calculate, measure and know the relation between basic electronics parameters

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & (50% of External Assessment)

L: 0	**T:** 0	**P:** 2	**C:** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	**Practical Title**
Practical-1.	Verification of Ohms Law.
Practical-2.	Verification of KCL and KVL for DC Circuits.
Practical-3.	Verification of Superposition Theorem.
Practical-4.	Verification of Thevenin`s Theorem
Practical-5.	Verification of Norton`s Theorem
Practical-6.	Verification of Maximum Power Transfer Theorem
Practical-7.	Calculations and Verification of Impedance and Current of RL, RC and RLC series Circuits.
Practical-8.	Measurement of Voltage, Current and Real Power in primary and Secondary AC Circuits
Practical-9.	The identification & Testing of Electronic component.
Practical-10.	Diode Characteristics (Si) a) Forward Bias b) Reverse Bias
Practical-11.	Study and analysis of half Wave rectifier with & without filter.
Practical-12.	Study and analysis of full Wave rectifier with & without filter.
Practical-13.	Transistor CE Characteristics (I/P & O/P)

Text Books:

1. Robert L. Boylestand / Louis Nashelsky "Electronic Devices and Circuit Theory", Pearson Education.
2. R. Muthusubramanian, S. Salivahanan, "Basic Electrical and Electronics Engineering", Tata McGraw-Hill Education, Reprint 2012
3. George Kennedy, "Electronic Communication Systems", McGraw Publication

Reference Books:

1. David A. Bell, "Electronic Devices and Circuits", Oxford University Press.
2. Jacob Millman, C.C. Halkias, StayabrataJit, "Electronic Devices and Circuits", McGraw Hill
4. David A. Bell, Electronic Instrumentation and Measurements, Latest Edition, Oxford Uni Press India

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3)External Practical Assessment	External Assessment	20
4)Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Create basic electrical connections for domestic applications	**L2 & L3**
CO-2	Measure the various electrical parameters in the DC circuit	**L3 &L4**
CO-3	Measure the various electrical parameters in the AC circuit	**L1& L3**
CO-4	To study basic electronic components.	**L2 & L3**
CO-5	To get the practical expose of the Transistors applications.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	2	2	1	0	0	0	0	1	2
CO-3	3	3	2	2	1	0	0	0	0	0	1	2
CO-4	3	3	2	2	2	0	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: ELECTRICAL & ELECTRONICS IN THE MODERN WORLD**
Course Code: ENEE-121	**Title: ELECTRICAL & ELECTRONICS IN THE MODERN WORLD**

Course Objectives:

1. To provide students with a foundation in basic electrical and electronic principles.
2. To develop the ability to simplify complex DC networks
3. To introduce semiconductors and devices used in computers and modern electronics.
4. To connect electronics concepts with applications in computing, IoT, and automation.
5. To enable students to perform simple hands-on experiments using electronic components and microcontrollers.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	**T:** 1	**P:** 0	**C:** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Fundamentals of Electrical & Circuits** • Voltage, current, resistance, power (basic quantities) • Passive Components: Resistors, capacitors, inductors: functions, uses, and color coding • Ohm's Law and simple circuit calculations • Series and parallel combination of resistance, • AC vs DC supply (very basic introduction) • Application: Power supply in computers, mobile	**9L**
II	**DC Circuits** • Introduction to DC circuits, • Star-Delta conversion. • Kirchhoff's laws, • Mesh and nodal methods of analysis, • DC theorems: Thevinen's Theorem Norton's theorem, Maximum Power Transfer Theorem,	**9L**
III	**Introduction to Electronics: Semiconductor Basics & Devices** • Difference between electrical and electronics	**9L**

	• Role of electronics in computing, communication, healthcare, and automation • Conductors, semiconductors, insulators • Intrinsic & extrinsic semiconductors (p-type, n-type – simple explanation) • Active Components: Diodes, transistors, LEDs, ICs • PN junction diode: forward/reverse bias, • Transistors: concept as switch & amplifier	
IV	**Digital Electronics & Logic** • Binary number systems & voltage levels (0s and 1s) • Logic gates: AND, OR, NOT, NAND, NOR (truth tables & symbols) • Simplification of Boolean functions using K- Mapp (Upto 4 variables) • Simple combinational logic (half adder, encoder/decoder – basic idea)	**9L**
V	**Electronics in the Modern World** • Motherboards, chipsets, RAM, processors (basic blocks) • Consumer electronics: smartphones, smart TVs, laptops • Computer hardware: power supply, microprocessor basics • IoT and Embedded Systems: microcontrollers (Arduino, Raspberry Pi), sensors & actuators • Applications in automation, wearables, renewable energy devices • Emerging technologies: AI chips, quantum computing (intro only)	**9L**

Text Books:

1. Robert L. Boylestand / Louis Nashelsky "Electronic Devices and Circuit Theory", Pearson Education.
2. R. Muthusubramanian, S. Salivahanan, "Basic Electrical and Electronics Engineering", Tata McGraw-Hill Education, Reprint 2012
3. George Kennedy, "Electronic Communication Systems", McGraw Publication

Reference Books:

1. David A. Bell, "Electronic Devices and Circuits", Oxford University Press.
2. Jacob Millman, C.C. Halkias, Stayabrata Jit, "Electronic Devices and Circuits", McGraw Hill
3. David A. Bell, Electronic Instrumentation and Measurements, Latest Edition, Oxford Uni Press India

If the course is available as **Generic Elective**, then the students of following departments may opt it: NO

Evaluation/Assessment Methodology	
Category	**Max. Marks**
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Physics of Class 12

Course Learning Outcomes:

CO-1	Apply the fundamental laws of electricity and circuit analysis to solve basic AC/DC circuit problems.	**L2 & L3**
CO-2	**Analyze** DC circuits using Kirchhoff's laws, network theorems, and circuit simplification methods.	**L3 &L4**
CO-3	**Explain** the working of semiconductor devices and their applications in switching and amplification.	**L1& L3**
CO-4	**Demonstrate** the use of digital electronics concepts including number systems, logic gates, and basic combinational circuits.	**L2 & L3**
CO-5	**Recognize** modern electronic systems, IoT devices, and emerging technologies in computing and automation.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: Introduction to CNC and 3-D Printer Lab**
Course Code: ENME-123P	**Title: Introduction to CNC and 3-D Printer Lab**

Course Objectives:

1. Understanding CNC and 3D Printing Technologies
2. Gain hands-on experience with CNC machines and 3D printers, including setup, operation, maintenance, and troubleshooting.
3. Identify and select appropriate materials for CNC machining and 3D printing based on their properties and application requirements.
4. Apply quality control methods and standards to ensure the production of high-quality parts.\
5. Explore the diverse industry applications of CNC machining and 3D printing, including automotive, aerospace, healthcare, and consumer products

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Marks (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Overview of CNC machine components and functions.
Practical-2.	Introduction to G-code and M-code.
Practical-3.	Writing simple CNC programs for basic shapes (e.g., square, circle).
Practical-4.	Loading and securing the workpiece along with tool selection and tool path setup.
Practical-5.	Programming and executing 2D milling operations to Creating a flat surface, slot, and pocket milling.
Practical-6.	Overview of CNC lathe operations along with programming and executing turning operations (e.g., facing, turning, threading).
Practical-7.	Introduction to CNC simulation software and Simulating CNC programs to verify tool paths and operations.
Practical-8.	Overview of 3D printing technology and applications along with Safety procedures and lab protocols.
Practical-9.	Understanding the parts of a 3D printer. With Basics of printer maintenance and troubleshooting. .
Practical-10.	Introduction to CAD software (e.g., Tinkercad, Fusion 360).

Practical-11.	Designing simple 3D models for printing.
Practical-12.	Introduction to slicing software (e.g., Cura, Prusa Slicer).
Practical-13.	Developing a small project that incorporates both CNC and 3D printing techniques

Reference/Text Books:

1. *"CNC Programming" S K Sinha*
2. *" Functional Design for 3D" by Mr Clifford T Smyth*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3)External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Understanding CNC and 3D Printing Technologies	**L2 & L3**
CO-2	Gain hands-on experience with CNC machines and 3D printers, including setup, operation, maintenance, and troubleshooting.	**L3 &L4**
CO-3	Understand the properties and selection criteria of various materials used in CNC machining and 3D printing	**L1& L3**
CO-4	Develop skills in designing 3D models suitable for CNC machining and 3D printing, including considerations for manufacturability and printability.	**L2 & L3**
CO-5	Understand quality control methods and standards for parts produced by CNC machining and 3D printing.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I/II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: Mechanical Workshop Lab**
Course Code: ENME-112P/ENME-122P	**Title: Mechanical Workshop Lab**

Course Objectives:

1. To understand the importance of tools used in workshop.
2. To prepare various joints used in workshop.
3. To identify & apply the most appropriate tools for various applications.
4. To perform the various types of black smithy and sheet metal shop operations.
5. Introduce students to the fundamentals of Computer Numerical Control (CNC) machines, including their components, operation principles, and applications in modern manufacturing.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 3	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Module-1	**Carpentry Shop:** **Practical-1:** To prepare half-lap corner joint. **Practical-2:** To prepare mortise & Tenon joint. **Practical-3:** To prepare a cylindrical pattern on woodworking lathe
Module-2	**Fitting Bench Working Shop:** **Practical-1:** To prepare a V-joint fitting **Practical-2:** To prepare a U-joint fitting **Practical-3:** To make a perfect square job
Module-3	**Black Smithy Shop:** **Practical-1:** To prepare a square rod from given circular rod. **Practical-2:** To prepare a square S- shape from given circular rod. **Practical-3:** To prepare a nail from given circular rod.
Module-4	**Welding Shop:** **Practical-1:** To prepare a butt welded joints using arc welding machine. **Practical-2:** To prepare a "T" welded joints using MIG welding machine. **Practical-3:** To prepare a Lap welded joint using resistance spot welding machine.
Module-5	**Sheet-metal Shop:** **Practical-1:** To make round duct of GI sheet using 'soldering' process. **Practical-2:** To prepare a tray of GI by fabrication

Module-6	**Machine Shop:** **Practical-1:** To prepare a bolt on the lathe machine as per given. Diagram. **Practical-2:** To prepare a slot on the horizontal milling machine as per given diagram.
Module-7	**Foundry Shop:** **Practical-1:** To prepare core as per given size. **Practical-2:** To prepare a mould for given casting.
Module-8	**CNC Shop:** **Practical-1:** Learn about the components of a CNC machine and their functions. **Practical-2:** Learn how to set up a work piece in the CNC machine (fixturing, tooling, work holding). **Practical-3:** Understand the process of loading tools into the machine and tool length offsets. **Practical-4:** Mount the cutting tool on the tool post and set its position relative to the work piece. **Practical-5:** To prepare a turning job on a CNC lathe machine according to a given diagram.

Reference/Text Books:

1. *A Course In Workshop Technology (Manufacturing Processes Vol. 1, B.S. Raghuwanshi, Publisher, Dhanpat Rai & Co.*
2. *Manufacturing Processes, Kumar & Gupta, Prentice Hall India.*
3. *Production Technology, Jain, Khanna Publications.*
4. *CNC Machining for Beginners by Paul Smith*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce (External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Understand the tools used in workshop & their applications.	**L2 & L3**
CO-2	Prepare various joints used in carpentry, fitting and welding shop.	**L3 &L4**
CO-3	Identify & apply the most appropriate tools for various manufacturing operations like turning, facing and threading.	**L1& L3**
CO-4	Perform the various types of black smithy and sheet metal shop operations.	**L2 & L3**
CO-5	Students will demonstrate proficiency in setting up CNC machines, loading programs, and executing machining operations to achieve specified dimensions and tolerances.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	0	3	0	0	0	1	0	0	2	1
CO-2	0	3	3	3	0	1	3	1	1	1	2	1
CO-3	0	2	2	2	3	2	0	0	0	2	2	2
CO-4	0	2	2	1	2	1	0	0	0	0	3	1
CO-5	1	2	1	1	1	0	0	0	0	0	0	0

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I/II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: Engineering Graphics & Design Lab**
Course Code: ENME-113P/ ENME-123P	**Title: Engineering Graphics & Design Lab**

Course Objectives:

1. To study the standard and rules to be trailed by engineers for making precise drawings.
2. To understand the fundamental dimensioning practices that must be continued in the arrangement of drawings.
3. To draw the various types of projection of lines, planes and solids.
4. To apply the CAD for design.
5. To create the engineering models.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 1

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Introduction to Engineering Drawing, Orthographic Projections: Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain and Diagonal Scales. Principles of Orthographic Projections – Conventions – Projections of Points and Lines inclined to both planes; Projections of planes inclined Planes – Auxiliary Planes.
Practical-2.	Projections and Sections of Regular Solids: Sections in lined to both the Planes – Auxiliary Views; Simple annotation, dimensioning and scale. Floor plans they include: windows, doors. Prism, Cylinder, Pyramid, Cone – Auxiliary Views.
Practical-3.	Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conversions.
Practical-4.	Computer Graphics: Listing the computer technologies the impact on graphical communication, Demonstration knowledge of the theory of CAD software [such as: The Menu System, Tollbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects: Isometric Views of lines, Planes, Simple and compound Solids];

Practical-5.	Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen), Computer-aided design (CAD) software modeling of parts and assemblies.

Reference/Text Books:

1. Engineering Drawing, Bhatt N.D., Panchal V.M. & Ingle P.R. (2014), Charotar Publishing House.
2. Engineering Drawing, Narayana, K.L. & P Kannaiah (2008), Scitech Publishers.
3. Engineering Drawing Paperback, P.S. Gill (Author), S.K. Kataria & Sons.
4. Engineering Drawing and Computer Graphics, Shah, M.B. & Rana B.C. (2008), Pearson Education.
5. Engineering Graphics, Agrawal B. & Agrawal C.M. (2012), TMH Publication.
6. Engineering Graphics & Design, A.P. Gautametc, Khanna Publishing House.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce (External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Understand the basic concepts and principles of engineering graphics and their significance.	**L2 & L3**
CO-2	Understand the theory of projections and regular solids.	**L3 &L4**
CO-3	Draw the various types of projection of lines, planes and solids.	**L1& L3**
CO-4	Apply the CAD for design.	**L2 & L3**
CO-5	Creating the engineering models using solid modeling.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	0	0	0	0	1	0	0	0	2	0	0
CO-2	3	2	0	0	0	1	0	0	0	0	0	0
CO-3	3	0	3	0	1	0	0	0	0	2	0	0
CO-4	2	0	2	0	3	0	0	0	0	1	0	0
CO-5	2	0	3	1	3	0	0	0	0	0	2	0

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: II**
Credits: NA **Theory: 0** **Practical: 0**	**SUBJECT: SPIRITUAL AND CULTURAL HERITAGE: INDIAN EXPERIENCE**
Course Code: ENPH-111	**TITLE: SPIRITUAL AND CULTURAL HERITAGE: INDIAN EXPERIENCE**

Course Objectives:
1. To provide an overview of the foundations of Indian knowledge systems through the Vedas, Upanishads, epics, and traditional sciences.
2. To develop appreciation for India's rich heritage in art, architecture, literature, and languages.
3. To introduce the major Indian philosophical schools and contributions of spiritual thinkers.
4. To foster understanding of cultural identity and values rooted in Indian traditions
5. To highlight the modern relevance and global impact of Indian knowledge and heritage.

Nature of Paper: Audit Course (Lab)

Minimum Passing Marks/Credits: NA

L :	T : 0	P : 2	C : 0

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to Indian Knowledge Systems and Cultural Identity	**4L**
II	Vedas, Upanishads, Epics and Traditional Indian Sciences	**4L**
III	Art, Architecture, Literature and Languages of India	**4L**
IV	Indian Philosophical Schools and Spiritual Thinkers	**4L**
V	Modern Relevance and Global Impact of Indian Heritage	**4L**

Text Books:
1. The Essentials of Indian Philosophy by M. Hiriyanna. Motilal Banarsidass
2. Indian Philosophy by S. Radhakrishnan, Oxford University Press.
3. India: A Sacred Geography by Diana L. Eck. Three Rivers Press
4. The Wonder That Was India **by** A.L. Basham, Picador.
5. Cultural Heritage of India (Vols 1–5) by Ramachandra Rao, Bharatiya Vidya Bhavan

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	NA
2) Presentations /Seminar	25

3) Assignments	NA
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	NA
Total:	**NA**

Prerequisites for the course: NA

Course Learning Outcomes:

CO-1	Recognize the diversity and unity of Indian cultural traditions.	**L2 & L4**
CO-2	Understand the philosophical and spiritual essence of Indian scriptures.	**L3 &L4**
CO-3	Analyze the contributions of Indian heritage to global knowledge systems.	**L3 & L4**
CO-4	Appreciate art, literature, architecture and their cultural context.	**L2 & L3**
CO-5	Develop respect for Indian values, thought, and wisdom traditions.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	1	0	1	0	1	0	0	0	0	0	0	0
CO-2	0	1	1	1	1	1	0	0	0	0	0	0
CO-3	1	1	0	1	0	0	0	0	0	0	0	0
CO-4	0	0	0	1	1	1	0	0	0	0	0	0
CO-5	0	1	1	0	0	1	0	0	0	0	0	0

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**	**Year: I** **Semester: II**
Credits: NA **Theory: 0** **Practical: 0**	**Subject: APPLIED DIFFRENTIAL EQUATIONS**
Course Code: ENAS-121	**Title: APPLIED DIFFRENTIAL EQUATIONS**

Course Objectives:

1. To understand the effective mathematical tools for the solutions of differential equations that model physical processes.
2. To get the idea of types of partial differential equations and their solutions.
3. To understand the concept of Laplace Transform and its application to solve differential and integral equations.
4. To understand and apply the foundational knowledge and analytical skills of Fourier series in solving engineering problems.
5. To equip students with the knowledge and skills to formulate and solve linear programming problems for optimal decision-making in engineering applications.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: NA

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**ORDINARY DIFFERENTIAL EQUATIONS:** Linear differential equation of nth order with constant coefficients, Simultaneous linear differential equations, Second order linear differential equations with variable coefficients, Solution by changing independent variable, Reduction of order, Normal form, Method of variation of parameters, Cauchy-Euler equation.	9L
II	**PARTIAL DIFFERENTIAL EQUATIONS:** Origin of Partial Differential Equations, Linear and Non Linear Partial Equations of first order, Lagrange's Equations, Charpit's method, Solution of Linear Partial Differential Equation of Higher order with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients.	9L
III	**LAPLACE TRANSFORM:** Laplace transform, Existence theorem, Laplace transforms of derivatives and integrals, Initial and final value theorems, Unit step function, Dirac- delta function, Laplace transform of periodic function, Inverse Laplace transform, Convolution theorem, Application to solve simple linear and simultaneous differential equations.	9L

IV	**FOURIER SERIES:** Euler's Formulae, Functions having arbitrary periods,πPeriodic functions, Fourier series of period 2 Change of interval, Even and odd functions, Half range sine and cosine series.	**9L**
V	**Linear Programming and Optimization:** Definition and importance of Linear Programming in engineering and optimization, Real-life applications of Linear Programming in various fields, Formulation of Linear Programming Problems, Solution of Linear Programming Problems using the Graphical Method, Simplex Method, Concept of duality in Linear Programming, Dual Simplex Method.	**9L**

Text Books:

1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*
4. *S.D. Sharma, Operation Research, Kedar Nath Ram Nath Publications*

Reference Books:

1. *E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.*
2. *Veerarajan T., Engineering Mathematics for first year, McGraw-Hill, New Delhi, 2008.*
3. *R K. Jain & S R K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House 2002*
4. *H.A. Taha, Operation Research-An introduction, Printice Hall of India*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Engineering Mathematics-I (RTAS-111)

Course Learning Outcomes:

CO-1	to solve linear differential equations of nth order with constant coefficients, and apply methods to solve various types of differential equations including Cauchy-Euler equations.	**L2 & L4**
CO-2	to formulate and solve first and higher-order partial differential equations using methods like Lagrange's equations, Charpit's method	**L3 &L4**
CO-3	demonstrate proficiency in using Laplace transforms to solve differential equations using theorems related to initial and final values, convolution, and the inverse Laplace transform.	**L3 & L4**
CO-4	able to represent periodic functions using Fourier series, understand and apply Euler's formulas, and construct Fourier series for functions of arbitrary periods and half-range expansions, identifying even and odd functions.	**L2 & L3**

CO-5	will develop the ability to formulate linear programming problems, solve them and understand the concept of duality in linear programming, with applications to real-life optimization problems in various fields.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	2	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	3	3	2	0	0	0	0	0	1	3
CO-4	3	3	2	3	2	1	0	0	0	0	1	2
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**	**Year: I** **Semester: II**
Credits: NA **Theory: 0** **Practical: 0**	**SUBJECT: HEALTH AND WELLNESS**
Course Code: ENHW-121	**TITLE: HEALTH AND WELLNESS**

Course Objectives:

1. To introduce the concept and dimensions of health and wellness for a balanced lifestyle.
2. To develop awareness about nutrition, physical activity, and preventive measures against lifestyle diseases.
3. To promote mental and emotional well-being through stress management, mindfulness, and emotional intelligence.
4. To create awareness about substance abuse, its health risks, and strategies for prevention.
5. To educate students on public health practices, hygiene, first-aid, and digital wellness.

Nature of Paper: Audit Course (Lab)

Minimum Passing Marks/Credits: NA

L :	**T : 0**	**P :** 2	**C :** 0

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to Health and Wellness: Definition and dimensions of health, importance of wellness, lifestyle diseases and their prevention.	**4L**
II	Nutrition and Physical Activity: Basics of a balanced diet, nutrients and their sources, physical activity guidelines, benefits of exercise and yoga.	**4L**
III	Mental and Emotional Well-being: Understanding stress, coping mechanisms, emotional intelligence, mindfulness practices, importance of sleep.	**4L**
IV	Substance Abuse and Health Risks: Awareness about tobacco, alcohol, drugs; addiction prevention; understanding peer pressure and making informed choices.	**4L**
V	Public Health and Digital Wellness: Hygiene and sanitation, preventive healthcare, first-aid basics, digital wellness, screen time management, online health resources.	**4L**

Text Books:

1. Textbook of Health and Physical Education by Dr. V.K. Sharma, Saraswati House
2. Health and Wellness by Dr. Anjali Arora. Penguin Books India
3. The Wellness Sense by Om Swami, Jaico Publishing House
4. Essentials of Physical Education by K. Goel, Goyal Brothers Prakashan
5. Fitness and Wellness by Wener W.K. Hoeger & Sharon A. Hoeger, Cengage Learning

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology	
Category	**Max. Marks**
1) Class tasks/ Sessional Examination	NA
2) Presentations /Seminar	25
3) Assignments	NA
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	NA
Total:	**NA**

Prerequisites for the course: NA

Course Learning Outcomes:

CO-1	Understand the importance of holistic health and identify factors affecting wellness.	**L2 & L4**
CO-2	Apply principles of nutrition and physical fitness for a healthy lifestyle.	**L3 &L4**
CO-3	Demonstrate awareness of mental and emotional health practices.	**L3 & L4**
CO-4	Recognize harmful substances and develop resistance to negative peer influence.	**L2 & L3**
CO-5	Practice good hygiene and digital wellness using available health resources.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	1	0	1	0	1	0	0	0	0	0	0	0
CO-2	0	1	1	1	1	1	0	0	0	0	0	0
CO-3	1	1	0	1	0	0	0	0	0	0	0	0
CO-4	0	0	0	1	1	1	0	0	0	0	0	0
CO-5	0	1	1	0	0	1	0	0	0	0	0	0

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Fundamental Concepts and Problem Solving with Python**
Course Code: ENCS-121	**Title: Fundamental Concepts and Problem Solving with Python**

Course Objectives:
1. To be able to introduce core programming basics.
2. To understand a range of Object-Oriented Programming, as well as in-depth data and information processing techniques.
3. To understand data types, statement, operators, modules, list, tuple, and dictionaries.

Nature of Paper: VAC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Python Programming:** History and evolution of Python, Features and advantages, Installation and setup (Python IDEs, Jupyter Notebook, Anaconda) **Basic Syntax:** Python syntax and semantics, Writing and executing a Python script, Indentation and code structure **Data Types and Variables:** Basic data types (int, float, str, bool), Variable declaration and assignment, Type conversion and casting **Operators and Expressions:** Arithmetic, relational, logical, and bitwise operators, Operator precedence and associativity.	9L
II	**Control Structures and Functions:** **Control Flow Statements:** Conditional statements (if, if-else, nested if-else), Looping statements (for, while, nested loops), Control statements (break, continue, pass), **Functions:** Defining and calling functions, Function arguments and return values, Recursion, Lambda functions and anonymous functions, **Modules and Packages:** Importing modules and using standard libraries, Creating and using custom modules, Introduction to virtual environments	9L
III	**Data Structures in Python:** **Strings:** String operations and methods, String formatting and manipulation, **Lists:** List operations and methods, List comprehensions, Nested lists,	9L

	Tuple: Tuple operations and methods, Advantages of using tuples, **Dictionaries:** Dictionary operations and methods, Dictionary comprehensions, Nested dictionaries, **Sets:** Set operations and methods, Set theory operations (union, intersection, difference)	
IV	**Problem Solving and File Handling:** **Problem Solving Techniques:** Algorithm design and pseudocode, Flowcharts, Debugging and testing, Exception handling (try, except, finally) **File Handling:** Reading from and writing to files, File methods and operations (open, close, read, write, append), Working with CSV and JSON files **Regular Expressions:** Introduction to regular expressions, Using the **re** module for pattern matching	**9L**
V	**Advanced Topics and Future Technologies:** **Object-Oriented Programming (OOP):** Classes and objects, Inheritance, polymorphism, encapsulation, and abstraction, Magic methods and operator overloading **Introduction to Data Science:** Basics of NumPy and Pandas, Data analysis and manipulation, Visualization with Matplotlib and Seaborn. **Future Prospects:** Career opportunities and industry trends, Ethical considerations in technology	**9L**

Text Books:
1. Python Crash Course.
2. Head-First Python, 2nd edition

Reference Books:
1. Guido van Rossum, and Fred L. Drake, Jr. (Editor)ISBN: 1906966141
2. Network Theory Ltd, 120 pages (Revised November 2006)

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	**Max. Marks**
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: solid computer literacy.

Course Learning Outcomes:

CO-1	To define the structure and components of a Python program.	**L2 & L3**
CO-2	To learn how to build and package Python modules for reusability.	**L3 &L4**
CO-3	To learn how to write functions and pass arguments in Python.	**L1& L3**
CO-4	To learn how to read and write files in Python.	**L2 & L3**

CO-5	To learn how to design object-oriented programs with Python classes.	L2& L4

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	1	0	3	0	0	0	0	0	0	1
CO-2	3	2	2	0	3	0	0	0	0	0	1	2
CO-3	3	3	2	0	3	0	0	0	0	0	0	2
CO-4	3	3	1	0	3	0	0	0	0	0	1	2
CO-5	3	3	3	0	3	2	0	0	0	0	2	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**	**Year: I** **Semester: II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: Fundamental Concepts and Problem Solving with Python Lab**
Course Code: ENCS-121P	**Title: Fundamental Concepts and Problem Solving with Python Lab**

Course Objectives:

1. Develop proficiency in writing and executing basic Python programs
2. Implement core programming concepts including conditional statements, loops, and functions through practical tasks
3. Enhance problem-solving skills by tackling tasks such as swapping values without a third variable
4. Gain a strong grasp of data structures like lists, tuples, and dictionaries, and practice algorithms for operations like merging sorted lists, removing duplicates, and counting specific elements
5. Explore advanced Python features and libraries by creating classes, utilizing random functions

Nature of Paper: VAC (Lab)

Minimum Passing Marks/Credits: 50% marks / 1 Credits (50% of Internal Assessment&50% of External Assessment)

L: 0	**T:** 0	**P:** 2	**C:** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	**Practical Title**
Practical-1.	Write a Python program to print "Hello, World!".
Practical-2.	Implement a calculator that can perform addition, subtraction, multiplication, and division.
Practical-3.	Determine if a given year is a leap year.
Practical-4.	Swap the values of two variables without using a third variable.
Practical-5.	Check if a given string is a palindrome.
Practical-6.	Determine the maximum of three given numbers.
Practical-7.	Check if a number is an Armstrong number.
Practical-8.	Merge two sorted lists into a single sorted list.
Practical-9.	Remove duplicate elements from a list.
Practical-10.	Python program to count positive and negative numbers in a list.
Practical-11.	Python Program to Accept the Strings Which Contains all Vowels.
Practical-12.	Write a python Programming to find Maximum record value key in dictionary
Practical-13.	Python program to find tuple which have all elements divisible by K from a list of

	tuple
Practical-14.	Write a Python program to create a calculator class. Include methods for basic arithmetic operations.
Practical-15.	Write a Python function to find the maximum of three numbers.
Practical-16.	Write a Python program to select a random element from a list, set, dictionary-value, and file from a directory. Use random. Choice().
Practical-17.	Write a Python program to check if a function is a user-defined function or not. Use types. Function Type, types. Lambda Type().

Reference/Text Books:

- *Guido van Rossum, and Fred L. Drake, Jr. (Editor)ISBN: 1906966141*
- *Network Theory Ltd, 120 pages (Revised November 2006)*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	To Understand basic syntax of python implementation	**L2 & L3**
CO-2	To practically apply looping and conditional constructs	**L3 &L4**
CO-3	To implement program related with list data structure	**L1& L3**
CO-4	To implement various searching algorithm in python	**L2 & L3**
CO-5	To implement list, tuple, dictionary and modules	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	1	2	1	3	1	1	1	1	1	1	1
CO-2	3	2	2	2	3	1	1	1	2	1	1	2
CO-3	3	3	2	2	3	1	1	1	2	1	1	2
CO-4	3	2	2	2	3	1	1	1	2	1	1	2
CO-5	3	2	2	3	3	1	1	1	2	1	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**	**Year: I** **Semester: II**
Credits: NA **Theory: 0** **Practical: 0**	**Subject: Sports**
Course Code: SPT-PC-111	**Title: Sports**

Course Objectives: The objectives of studying this course are

1. To develop students' physical fitness, mental well-being, and proficiency in various individual and team sports through structured participation and practice.
2. To foster qualities of discipline, teamwork, sportsmanship, and strategic thinking by engaging students in competitive and recreational games and physical activities.

Nature of Paper: Core (Practical)

Minimum Passing Marks/Credits: NA

L: 0	**T:** 0	**P:** 2	**C:** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

S.No.	Contents	No. of Lectures Allotted
1	Archery/ Athletics/ Badminton/ Basketball/ Boxing/ Carrom/ Chess/ Cricket/ Football/ Handbal/l Judo/ Kabaddi/ Kho-Kho/ Martial Arts/ Powerlifting/ Table/ Tennis/ Volleyball/ Weightlifting/ Wrestling/ Yoga.	2L

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	15
2) Presentation/Seminar/Viva-Voce(Internal)		-
3) External Practical Assessment	External Assessment	35
4) Presentation/Seminar/Viva-Voce(External)		-
5) Practical Records		-
Total:		**50**

Prerequisites for the course: NA

Course Learning Outcomes:

CO-1	Demonstrate basic skills, rules, and techniques required for effective participation in individual sports such as athletics, archery, boxing, and martial arts.	**L3**

CO-2	Exhibit proficiency in team-based sports like football, basketball, volleyball, kabaddi, and kho-kho, with emphasis on coordination, communication, and team strategy	**L3, L4**
CO-3	Analyze and apply rules, scoring systems, and tactics in indoor games such as chess, carrom, and table tennis to enhance cognitive and decision-making skills.	**L4**
CO-4	Develop and maintain physical fitness, flexibility, and endurance through regular practice and participation in strength-based and aerobic activities such as yoga, powerlifting, and athletics	**L3**
CO-5	Demonstrate sportsmanship, ethical behavior, self-discipline, and leadership qualities both during practice and competitive events.	**L3,L5**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	2	1	2	1	1	–	–	–	2	1	–	2
CO-2	–	1	2	–	–	–	–	–	3	2	2	2
CO-3	1	2	–	–	1	–	–	2	2	2	–	2
CO-4	–	–	–	2	–	–	2	–	1	1	–	3
CO-5	–	–	–	–	–	3	–	3	3	2	3	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech ME**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Engineering Mathematics-III**
Course Code: RTAS-231	**Title: Engineering Mathematics-III**

Course Objectives: The objectives of studying this course are,
1. To make the students familiar with complex functions and its calculus.
2. To deal with applications, residues and conformal mapping.
3. To understand the concept and applications of integral transforms.
4. To deal with numerical solutions of algebraic equations and differential equations.
5. To understand the statistical aspect of functions.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Functions of a Complex Variable I**: Analytic functions; C-R equations and harmonic functions; Line integral in the complex plane; Cauchy's integral theorem, Cauchy's integral formula for derivatives of analytic functions; Liouvilles theorem.	9L
II	**Functions of a Complex Variable II**: Representation of a function by power series; Taylor's and Laurent's series; Singularities, zeroes and poles; Residue theorem, evaluation of real integrals; conformal mapping and bilinear transformations.	9L
III	**Integral Transforms:** Fourier integral, Fourier complex transform, Fourier sine and cosine transforms and applications to simple heat transfer equations. Z – Transform and its application to solve difference equations.	9L
IV	**Numerical Techniques:** Solution of polynomial and transcendental equations Bisection method, Regula – Falsi method, Newton - Raphson method. **Interpolation:** Finite difference, Newton's forward and backward interpolation, Lagrange's and Newton's divided difference formula for unequal intervals; **Numerical Differentiation**, **Numerical Integration**; Trapezoidal, Simpson's 1/3 and 3/8 rules. **Numerical solutions of first order differential equations** by Euler's method and 4th order Runge-Kutta method.	9L

V	**Statistical Techniques:** Moments, Moment generating functions, Skewness, Kurtosis, Curve Fitting and Solution of Equations: Method of least squares and curve fitting of straight line and parabola, Correlation and Regression, Binomial distribution, Poisson distribution, Normal distribution.	**9L**

Text Books:

1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*

References:

1. *E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.*
2. *Veerarajan T., Engineering Mathematics for first year, McGraw-Hill, New Delhi, 2008.*
3. *R K. Jain & S R K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House 2002.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	Understand the concept of number system, Logic Gates, Boolean algebra, K-map and Quine Mclusky method	**L1 & L2**
CO-2	Design combinational and sequential logic circuits and their applications	**L4 & L6**
CO-3	Understand concepts of Synchronous & Asynchronous Sequential Circuits	**L1 & L2**
CO-4	Understand the idea of Digital Logic Families, memory and Programmable Logic Devices	**L1 & L2**
CO-5	Apply the concept of Digital Logic Families with circuit implementation.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Engineering Mathematics-III (RTAS-231)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	3	2	3	1	0	0	0	0	0	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	2
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech ME**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Material Science**
Course Code: RTME-231	**Title: Material Science**

Course Objectives:

1. To understand the fundamental concepts of crystal structures, imperfections, and their impact on material properties.
2. To develop skills in measuring and interpreting mechanical properties of materials through various testing methods.
3. To interpret phase diagrams and understand microstructural development in alloys.
4. To explore heat treatment processes and their effects on steel microstructures and properties.
5. To study the properties and applications of various alloys, including steel, cast irons, and non-ferrous alloys.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	**T:** 1	**P:** 0	**C:** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Crystallography and Imperfections:** Introduction, Importance of materials Concept of unit cell, space lattice, Bravais lattices, common crystal structures; Atomic packing factor and density; X-ray crystallography techniques; Imperfections, Defects & Dislocations in solids.	9L
II	**Mechanical properties and Testing:** Stress-strain diagram; Ductile & brittle materials; Stress vs. Strength; Toughness, Hardness, Fracture, Fatigue and Creep; Testing: Strength testing, Hardness testing, Impact testing, Fatigue testing, Creep testing, Non-destructive testing (NDT). **Micro-structural Examination:** Microscope principle and methods; Preparation of samples and Microstructure examination and grain size determination; Comparative study of microstructure of various metals & alloys such as Mild Steel, GI, Brass.	9L
III	**Phase Diagrams:** Introduction, plotting of binary diagram, equilibrium cooling of an alloy, solid solutions, eutectic, eutectoid and peritectic systems, Iron-Iron carbide (Iron Carbon)equilibrium diagram- various phases present, various reactions involved, critical points, explanation of Iron Carbon diagram; phase rule.	9L

IV	**Heat treatment:** Annealing, tempering, normalizing and spheroidizing, isothermal transformation diagrams for Fe-C alloys and microstructure development, Continuous cooling curves and interpretation of final microstructures and properties, austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.	**9L**
V	Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons- copper and copper alloys; brass, bronze andcupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based super alloys and Titanium alloys.	**9L**

Text Books:

1. Material Science, R. K. Rajput, S.K. Kataria& Sons
2. Materials Science And Engineering, I.P. Singh, Subash Chander, & Rajesh Kumar Prasad, 13th edition, John brothers.
3. Material Science Material Science In Engineering, DR. K.M. GUPTA, Umesh

Reference Books:

1. Material Science and Engineering, V. Raghavan, Prentice Hall
2. Materials Science and Engineering An Introduction, W.D. Callister, John Wiley
3. Mechanical Behaviour of Materials, Courtney, McGraw-Hill

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Analyze crystal structures, imperfections, and mechanical properties using tensile, compression, and hardness tests.	**L2**
CO-2	Evaluate static and fatigue failure mechanisms using failure theories and stress-life approaches	**L2**
CO-3	Interpret binary phase diagrams and microstructural development in alloys, including Fe-C systems.	**L2**
CO-4	Apply heat treatment processes to control steel microstructures and properties.	**L4**
CO-5	Assess the properties and applications of steel, cast irons, and non-ferrous alloys.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Material Science (RTME-231)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	0	0	1	0	0	0	0	0	0	1
CO-2	3	3	2	2	2	0	0	0	0	0	0	1
CO-3	3	3	2	2	2	1	1	0	0	1	0	1
CO-4	3	3	2	2	2	1	1	0	0	1	0	1
CO-5	3	3	3	2	3	1	1	0	0	1	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech ME**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Engineering Thermodynamics**
Course Code: RTME-232	**Title: Engineering Thermodynamics**

Course Objectives:

1. To understand fundamental thermodynamic concepts, including systems, properties, processes, and equilibrium.
2. To apply the zeroth, first, second, and third laws of thermodynamics to analyze energy interactions in systems.
3. To evaluate work, heat, and energy transformations in closed and open systems using thermodynamic principles.
4. To analyze the concept of entropy, irreversibility, and thermodynamic potentials in various processes.
5. To study the properties of pure substances, particularly steam, and apply them to thermodynamic cycles like the Rankine cycle.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Basic Concepts of Thermodynamics**: Definitions, system, control volume, surrounding, boundaries, universe; Types of systems; Macroscopic and microscopic viewpoints; Thermodynamic equilibrium; State, property, process; Cycle - Reversibility - Quasi - static process; Irreversible process; Causes of irreversibility; Types of work and heat. **Zeroth law of thermodynamics:** concept of temperature and its measurement.	9L
II	**First Law of Thermodynamics**: Definition of work, displacement work and flow work. Joule experiment, First law of thermodynamics for closed system, Limitations of the first law. PMM-I. First law applied to a Process, applied to a flow system; Steady flow energy equation; Application of first law of thermodynamics, Steady flow energy equation.	9L
III	**Second law of thermodynamics:** Kelvin-Plank and Clausius statements and Equivalence of the two statements, PMM-II, Thermal reservoir; Heat engine; Heat pump; Parameters of performance; Reversible and irreversible processes and their corollaries; Carnot's Principle / Theorem; Carnot cycle and its specialties;	9L

IV	**Application of second law of thermodynamics and concept of Entropy:** Thermodynamic scale of temperature; Clausius Inequality; Entropy; Principle of entropy increase, entropy change of pure substance in different thermodynamics processes, T-ds equation. Statement of third law of thermodynamics. Energy equation; Availability and irreversibility; Thermodynamic potentials, Gibbs and Helmholtz Function.	**9L**
V	**Properties of steam and Rankine cycle:** Pure substance, Property of Pure Substance (steam), Triple point, Critical point, Saturation states, Subcooled liquid state, Superheated vapour state, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T, P-V and P-h diagrams, T-S and H-S diagrams, use of property diagram, Steam-Tables & Moller chart, Dryness factor and it's measurement, processes involving steam in closed and open systems. Simple Rankine cycle.	**9L**

Text Books:

1. Singh onkar, Applied Thermodynamics, New Age International (p) Publishers Ltd.
2. Ballaney P.L., Thermal Engineering , Khanna Publisher
3. Kearton W.J., Theory of Stream Turbine,I. Pitman.

Reference Books:

1. Rajput R.K. Thermal Engineering, Laxmi Publication
2. Nag PK. Engineering Thermodynamics, TMH
3. Yadav R. Heat Engines, CPH Allahabad

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Explain thermodynamic systems, properties, processes, equilibrium, and temperature measurement using the zeroth law.	**L2**
CO-2	Apply the first law of thermodynamics to analyze energy interactions in closed and open systems, including steady flow processes.	**L2**
CO-3	Evaluate the performance of heat engines, heat pumps, and reversible processes using the second law and Carnot principles	**L2**
CO-4	Analyze entropy changes, irreversibility, and thermodynamic potentials in various processes using Clausius inequality and T-ds equations.	**L2**

CO-5	Interpret the properties of steam using thermodynamic diagrams and apply them to analyze the Rankine cycle.	**L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Engineering Thermodynamics (RTME-232)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	1	1	1	0	0	0	0	0	0	1
CO-2	3	3	2	2	1	0	0	0	0	0	0	1
CO-3	3	3	2	2	1	1	1	0	0	0	0	1
CO-4	3	3	2	2	1	0	1	0	0	0	0	1
CO-5	3	2	3	2	2	2	2	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech ME**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Strength of Material**
Course Code: RTME-233	**Title: Strength of Material**

Course Objectives:

1. To develop the theoretical concept of stress and strain of solids.
2. To understand the mechanical behavior of the materials.
3. To enable students to find the bending moment and shear force at different cross section with different loading condition
4. To develop the ability in students to solve the numerical problems related to deflection, twisting moment and bending.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Stress And Strains:** Rigid bodies and deformable solids, Types of Stresses and Strains, Deformation of simple and compound bars, Thermal stresses, Elastic Properties of Materials, Volumetric strains, Stresses on inclined planes, principal stresses and planes.	9L
II	**Shear Force & Bending Moment, Bending Stress:** Beams, transverse loading on beams, Shear force and bending moment in Cantilevers, Simply supported beams and over – hanging beams, Theory of simple bending, bending stress distribution, Shear stress, Shear stress distribution for different cross section,	9L
III	**Torsion:** Pure torsion, Power transmission by shaft, Comparison between solid and hollow shaft, Torsion formulation stresses and deformation in circular solid and hollow shafts, Stepped shafts, Deflection in shafts fixed at the both ends	9L
IV	**Deflection of Beams:** Slope and deflection of simple supported and cantilever beams, Double integration method, Area moment method, Macaulay's method, castigliano's and Maxwell theorem	9L
V	**Columns and Struts:** Buckling and stability, Slenderness ratio, Combined bending & direct stress, Middle third & middle quarter rules, Struts with different end conditions, Euler's theory for pin ended	9L

	columns, Effect of end conditions on column buckling, Ranking Gordon formulae, .Theory of failure, Thin cylinders & Spheres, Difference between thin walled and thick walled pressure vessels	

Text Books:

1. Rajput R.K, Strength of Materials, S Chand & Company Ltd.
2. Bear Jhonson, Mechanics of Materials, Tata McGraw-Hill.

Reference Books:

1. Timoshenko, S.P., Gere, M.J., Mechanics of Materials, C.B.S., Publishers, 1980.
2. Ramamurtham, S., Strength of Materials,, Dhanpat Rai Publications, 2005.
3. Popov, E.P., Engineering Mechanics of Solids, Prentice-Hall, 1999.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the concepts of various types of stress and strain induced in the specimen/bodies.	**L2**
CO-2	Apply shear force and bending moment diagrams to analyze the resistance offered by the beam and able to solve practical problems.	**L4**
CO-3	Acquire the basic knowledge of pure torsion and power transmission through shaft (Solid & Hollow).	**L2**
CO-4	Design a component as per the requirement of safety standard.	**L2**
CO-5	Analyze slender, long columns subjected to axial loads.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Strength of Material (RTME-233)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	1	1	1	0	0	0	0	0	0	1
CO-2	3	3	3	2	1	1	0	0	0	0	1	1
CO-3	3	2	2	1	1	0	0	0	0	0	0	1
CO-4	3	2	3	2	2	2	1	1	0	0	1	2
CO-5	3	3	2	2	1	1	1	0	0	0	0	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech ME**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Introduction to MAT LAB**
Course Code: RSEE-231	**Title: Introduction to MAT LAB**

Course Objectives:

1. To introduce students to the MATLAB environment and its basic features.
2. To teach students how to use MATLAB for numerical computations, data analysis, and visualization.
3. To enable students to write simple MATLAB programs for solving engineering problems.
4. To familiarize students with MATLAB's capabilities in solving mechanical engineering problems, such as dynamics, vibrations, and heat transfer.
5. To prepare students for using MATLAB in their future engineering courses and projects.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to MATLAB** • Starting MATLAB, understanding the interface, using the help system • Variables, data types (scalars, arrays), operators • Basic input and output commands	9L
II	**Arrays and Matrices** • Creating and manipulating arrays and matrices • Matrix operations (addition, multiplication, transpose etc.) • Solving systems of linear equations (e.g., Ax = b) • Applications in mechanical engineering (e.g., solving for forces in trusses)	9L
III	**Plotting and Visualization** • 2D plotting (line plots, scatter plots) • 3D plotting for visualizing complex data • Customizing plots (labels, legends, titles, line styles) • Applications in mechanical engineering (e.g., plotting stress-strain curves, vibration modes)	9L
IV	**Programming in MATLAB** • Control structures (if-else, for loops, while loops) • Writing and using M-file scripts and functions	9L

	• Debugging techniques (breakpoints, error checking) • Applications (e.g., writing a function to calculate natural frequencies of a beam)	
V	**Advanced Topics for Mechanical Engineering** • Numerical methods: solving ordinary differential equations (ODEs), numerical integration • Data analysis: curve fitting, regression • Introduction to Simulink for modeling dynamic systems • Applications (e.g., modeling a mass spring-damper system, heat transfer in a fin)	**9L**

Text Books:
1. MATLAB for Engineers by Holly Moore, Pearson.
2. Introduction to MATLAB for Engineers by William J. Palm III, McGraw-Hill.

Reference Books:
1. MATLAB: A Practical Introduction to Programming and Problem Solving by Stormy Attaway, Elsevier.
2. Numerical Methods with MATLAB by Gerald Recktenwald, Prentice Hall.

If the course is available as **Generic Elective**, then the students of following departments may opt it: NO

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the MATLAB environment and perform basic operations.	L2
CO-2	Use MATLAB for array operations and solving linear equations.	L3
CO-3	Create and customize plots for data visualization.	L3
CO-4	Write and debug simple MATLAB programs.	L3
CO-5	Apply MATLAB to solve mechanical engineering problems, such as numerical methods and system modeling.	L4

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Introduction to MATLAB (RSEE-231)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	0	0	0	3	0	0	0	0	0	0	1
CO-2	3	2	0	0	3	0	0	0	0	0	0	0
CO-3	3	0	0	0	3	0	0	0	0	2	0	0
CO-4	3	2	0	0	3	0	0	0	0	0	0	1
CO-5	3	3	2	2	3	1	1	0	1	0	1	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech ME**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Material Science Lab**
Course Code: RTME -231P	**Title: Material Science Lab**

Course Objectives:

1. Demonstrate the basic principles in the area of strength and mechanics of materials and structural analysis to the undergraduate students through a series of experiments.
2. Provide fundamental knowledge based associated materials properties, and their selection and application.
3. Students would have acquired and developed the necessary background and skills for successful careers in the materials-related industries.
4. Performing grain structure analysis to assessing various grain sizes and their distribution, which gives insight into how these materials, can be used for practical purposes.
5. Experiments are performed to measure the properties of the materials such as impact strength, tensile strength, compressive strength, hardness, ductility etc.

Nature of Paper: Core (Practical)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of ESE & 40% of total)

L: 0	T: 0	P: 2	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
Practical-1	To make a plastic mould for small metallic specimen on plastic moulding machine.	**3L**
Practical-2	To prepare a Specimen for micro structural examination cutting, grinding, polishing, and etching.	**3L**
Practical-3	To determine grain Size of a given specimen.	**3L**
Practical-4	To compare micro-structures of different specimens (mild steel, gray C.I., brass, copper)	**3L**
Practical-5	To study of micro-structure of welded component using microscope.	**3L**
Practical-6	To determine tensile strength of a given mild steel specimen on UTM and plot a stress-strain graph.	**3L**
Practical-7	To determine impact strength using Charpy and Izod testing machine.	**3L**
Practical-8	To perform hardness test on given mild steel specimen and compare Brinell hardness and Rockwell hardness.	**3L**

Practical-9	To determine fatigue strength fatigue testing machine.	**3L**
Practical-10	To determine deflection of beam and comparison of actual measurement of deflection with dial gauge to the calculated one, and evaluation of young's modulus of beam.	**3L**
Practical-11	To determine Spring index on spring testing machine.	**3L**
Practical-12	To determine torsion strength of a rod on torsion testing machine.	**3L**

Text Books:

1. Material Science and Engineering (SIE) with CD, by Smith, McGraw Hill.
2. Mechanical Metallurgy, by G. Dieter, McGraw Hill.
3. Engineering Mechanics and Composite Materials, by Daniels, Oxford University Press.

Reference Books:

1. Engineering Materials: Polymers, Ceramics and Composites, by A.K Bhargava, Prentice Hall India.
2. Materials characterization, Vol. 10, ASM hand book.
3. Analysis and Performance of Fiber Composites, by Agarwal, McGraw Hill.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Practical file report	10
2) Practical viva	05
3) End semester practical exam	35
Total:	**50**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the microstructural examination procedure such as-cutting, grinding, polishing, etching	**L2**
CO-2	Find out the grain size of given specimen and analysis the impact of grain size on material properties.	**L4**
CO-3	Learn to develop specimen and conduct microstructure analysis of welded joint.	**L2**
CO-4	Determine the strength of material by performing various hardness test example Brinell hardness and Rockwell hardness.	**L2**
CO-5	Students learn to determine the strength of mild steel specimen on UTM.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Material Science Lab (RTME-231P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	0	2	3	0	0	0	2	2	0	1
CO-2	3	3	0	3	2	0	0	0	2	2	0	1
CO-3	3	2	1	2	3	0	0	0	2	2	0	1
CO-4	3	2	0	3	3	0	0	0	2	2	0	1
CO-5	3	2	0	3	3	0	0	0	2	2	0	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech ME**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Engineering Thermodynamics Lab**
Course Code: RTME -232P	**Title: Engineering Thermodynamics Lab**

Course Objectives:
1. To learn about work and heat interactions, and balance of energy between system and its surroundings.
2. To learn about application of I law to various energy conversion devices.
3. To evaluate the changes in properties of substances in various processes.
4. To understand the difference between high grade and low-grade energies and II law limitations on energy conversion.

Nature of Paper: Core (Practical)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of ESE & 40% of total)

L: 0	T: 0	P: 3	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
Practical-1	To study of Fire Tube boiler & water tube boiler	**3L**
Practical-2	To study the working of Refrigerator	**3L**
Practical-3	To study of velocity and pressure compounded steam turbine	**3L**
Practical-4	To study of impulse & Reaction turbine.	**3L**
Practical-5	To study of steam Engine model.	**3L**
Practical-6	To study and working of two and four stroke petrol Engine	**3L**
Practical-7	To determine the Indicated H.P. of I.C. Engine by Morse Test	**3L**
Practical-8	To study of Gas Turbine Model	**3L**
Practical-9	To study & working of Air conditioner	**3L**
Practical-10	To prepare the energy balance for Diesel/Petrol Engine	**3L**
Practical-11	To study & working of two stroke Diesel Engine	**3L**
Practical-12	To study of Ignition system of I.C. Engine.	**3L**

Text Books:
1. Singh onkar, Applied Thermodynamics, New Age International (p) Publishers Ltd.
2. Ballaney P.L., Thermal Engineering, Khanna Publisher
3. Kearton W.J., Theory of Stream Turbine, I. Pitman

Reference Books:

1. Rajput R.K. Thermal Engineering, Laxmi Publication
2. Yahya SM. Turbine Compressor & Fans, TMH
3. Ganeshan, Gas Turbine, TMH
4. Yadav R. Heat Engines, CPH Allahabad
5. Nag PK. Engineering Thermodynamics, TMH

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Practical file report	10
2) Practical viva	05
3) End semester practical exam	35
Total:	**50**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To apply energy balance to systems and control volumes, in situations involving heat and work interactions	**L3**
CO-2	The students will be able to understand different turbines and its working.	**L2**
CO-3	The students will be able to understand boilers and constructions	**L2**
CO-4	The students will be able to differentiate between diesel and petrol engine	**L4**
CO-5	Students will be able to evaluate the performance of thermodynamic systems by analyzing efficiency and energy losses in practical setups	**L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Engineering Thermodynamics Lab (RTME-232P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	1	3	2	1	1	0	2	2	0	1
CO-2	3	2	1	2	2	1	1	0	2	2	0	1
CO-3	3	2	1	2	2	1	1	0	2	2	0	1
CO-4	3	2	1	2	2	1	1	0	2	2	0	1
CO-5	3	3	2	3	2	1	2	0	2	2	1	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech ME**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Strength of Material Lab**
Course Code: RTME -233P	**Title: Strength of Material Lab**

Course Objectives:

1. Provide hands-on experience in evaluating mechanical properties of materials under various loading conditions.
2. Develop skills in using experimental apparatus such as universal testing machines, hardness testers, and impact testing machines.
3. Enable students to analyze and interpret experimental data to understand material behavior under tensile, compressive, shear, torsional, and bending loads.
4. Verify theoretical concepts and theorems through practical experiments.
5. Foster an understanding of material properties like strength, hardness, toughness, rigidity, and elasticity for engineering applications.

Nature of Paper: Core (Practical)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of ESE & 40% of total)

L: 0	T: 0	P: 3	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
Practical-1	To determine the yield strength, ultimate strength, and elongation of a mild steel sample using a universal testing machine (UTM).	**3L**
Practical-2	To study the behavior of materials under axial compressive loads and determine compressive strength.	**3L**
Practical-3	To measure the hardness of metallic specimens using different hardness testing machines.	**3L**
Practical-4	To determine the toughness or impact strength of materials.	**3L**
Practical-5	To determine the modulus of rigidity and examine the behavior of a material under torsional loading.	**3L**
Practical-6	To determine the modulus of elasticity of a beam material by analyzing the bending stress and deflection.	**3L**
Practical-7	To calculate the deflection of beams under different loading and support conditions.	**3L**
Practical-8	To evaluate the shear strength of materials.	**3L**

Practical-9	To determine stiffness and modulus of rigidity using a spring testing apparatus.	**3L**
Practical-10	To verify the theorem for different loading conditions on a beam.	**3L**

Text Books:
1. Rajput R.K, Strength of Materials, S Chand & Company Ltd.
2. Bear Jhonson, Mechanics of Materials, Tata McGraw-Hill.

Reference Books:
1. Timoshenko, S.P., Gere, M.J., Mechanics of Materials, C.B.S., Publishers, 1980.
2. Ramamurtham, S., Strength of Materials, Dhanpat Rai Publications, 2005.
3. Popov, E.P., Engineering Mechanics of Solids, Prentice-Hall, 1999.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Practical file report	10
2) Practical viva	05
3) End semester practical exam	35
Total:	**50**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Conduct experiments to determine mechanical properties such as yield strength, ultimate strength, compressive strength, hardness, toughness, modulus of rigidity, and modulus of elasticity of various materials	**L2**
CO-2	Operate testing equipment (e.g., UTM, hardness testers, impact testers) accurately and safely to perform standardized material tests.	**L2**
CO-3	Analyze experimental data to calculate and interpret material properties, including stress, strain, deflection, and stiffness.	**L4**
CO-4	Apply theoretical concepts (e.g., Maxwell's Reciprocal Theorem) to practical scenarios and validate them through experimental results	**L3**
CO-5	Prepare technical reports summarizing experimental procedures, results, and conclusions, demonstrating effective communication skills.	**L2**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Strength of Material Lab (RTME-233P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	0	2	2	0	0	0	1	1	0	1
CO-2	2	1	0	2	3	1	0	1	2	0	0	1
CO-3	3	3	1	3	2	0	0	0	1	2	0	1
CO-4	3	3	0	2	1	0	0	0	1	1	0	2
CO-5	1	1	0	1	1	0	0	1	2	3	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech EE/EEE**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Integrated Communication Lab**
Course Code: RTAS-232P	**Title: Integrated Communication Lab**

Course Objectives: The objectives of studying this course are

1. To enhance students' English communication skills through structured practice in listening, speaking, reading, and writing activities relevant to academic and professional contexts.
2. To develop interpersonal and presentation skills required for group discussions, interviews, seminars, and workplace communication.
3. To build confidence in public speaking and professional interaction by encouraging active participation in role plays, debates, and extempore sessions.
4. To improve pronunciation, fluency, and vocabulary through language lab sessions and interactive modules.
5. To prepare students for industry and higher education opportunities by aligning communication training with real-world scenarios and corporate expectations

Nature of Paper: AECC (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (30% of ESE & 40% of total)

L: 0	T: 0	P: 2	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

No	Contents	No. of Lectures Allotted
1	Introduction to Integrated Communication Lab and activities for self-introduction and ice-breaking.	2L
2	Listening comprehension practice through audio clips and note-taking exercises.	2L
3	Role play and conversation practice for formal and informal situations.	2L
4	Group discussion and JAM (Just a Minute) session for fluency enhancement	2L
5	Reading comprehension and vocabulary-building exercises from short passages.	2L
6	Email and resume writing for academic and professional purposes.	2L
7	Report writing and paragraph writing on given topics.	2L
8	Mock interviews and feedback on spoken communication.	2L
9	Oral presentation on technical or general topics using PPT.	2L
10	Pronunciation, stress, and intonation practice through language lab software.	2L

Text Books:

1. Rizvi, M. Ashraf. (2005). Effective Technical Communication. New Delhi: Tata McGraw-Hill Education.
2. Kumar, Sanjay, & Lata, Pushp. (2018). Communication Skills. New Delhi: Oxford University Press.

Reference Books:

1. Meenakshi Raman & Sangeeta Sharma. (2015). Technical Communication: Principles and Practice (2nd ed.). New Delhi: Oxford University Press.
2. Carnegie, Dale. (1998). The Quick and Easy Way to Effective Speaking. New York: Pocket Books.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Prerequisites for the course: Electronics Engineering

Course Learning Outcomes:

CO1	Develop effective listening skills to comprehend and analyse spoken English in academic and professional settings.	**L2**
CO2	Demonstrate improved spoken English fluency, pronunciation, and confidence in group discussions, role plays, and interviews.	**L3**
CO3	Enhance reading comprehension skills to interpret and critically analyse a variety of texts and media.	**L2**
CO4	Acquire the ability to write structured and professional documents like emails, resumes, and short reports.	**L3**
CO5	Deliver formal presentations and interviews with clarity, organization, and effective verbal/non-verbal communication.	**L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Integrated Communication Lab (RTAS-232P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	1	1	0	0	1	0	0	1	2	3	1	1
CO-2	0	1	1	0	1	1	0	1	3	3	2	2
CO-3	1	1	0	0	1	0	0	1	2	2	1	1
CO-4	1	0	1	0	1	0	0	1	2	3	2	2
CO-5	0	0	1	0	2	0	0	1	3	3	2	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech ME**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Engineering Science Elective/ Mathematics-III**
Course Code: RTAS-231/ RESE-231-239	**Title: Engineering Science Elective/ Mathematics-III**

Course Objectives: The objectives of studying this course are,
1. To make the students familiar with complex functions and its calculus.
2. To deal with applications, residues and conformal mapping.
3. To understand the concept and applications of integral transforms.
4. To deal with numerical solutions of algebraic equations and differential equations.
5. To understand the statistical aspect of functions.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 30% of ESE & 40% of total

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Functions of a Complex Variable I**: Analytic functions; C-R equations and harmonic functions; Line integral in the complex plane; Cauchy's integral theorem, Cauchy's integral formula for derivatives of analytic functions; Liouvilles theorem.	9L
II	**Functions of a Complex Variable II**: Representation of a function by power series; Taylor's and Laurent's series; Singularities, zeroes and poles; Residue theorem, evaluation of real integrals; conformal mapping and bilinear transformations.	9L
III	**Integral Transforms:** Fourier integral, Fourier complex transform, Fourier sine and cosine transforms and applications to simple heat transfer equations. Z – Transform and its application to solve difference equations.	9L
IV	**Numerical Techniques:** Solution of polynomial and transcendental equations Bisection method, Regula – Falsi method, Newton - Raphson method. **Interpolation:** Finite difference, Newton's forward and backward interpolation, Lagrange's and Newton's divided difference formula for unequal intervals; **Numerical Differentiation**, **Numerical Integration**; Trapezoidal, Simpson's 1/3 and 3/8 rules.	9L

	Numerical solutions of first order differential equations by Euler's method and 4th order Runge-Kutta method.	
V	**Statistical Techniques:** Moments, Moment generating functions, Skewness, Kurtosis, Curve Fitting and Solution of Equations: Method of least squares and curve fitting of straight line and parabola, Correlation and Regression, Binomial distribution, Poisson distribution, Normal distribution.	**9L**

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.
2. B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.
3. Dass H.K., Engineering Mathematics Vol-I, S. Chand.

References:

1. E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.
2. Veerarajan T., Engineering Mathematics for first year, McGraw-Hill, New Delhi, 2008.
3. R K. Jain & S R K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House 2002.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	Understand and check the Analyticity of a complex function.	**L2 & L4**
CO-2	To apply the concept of Analytic functions in residue and conformal mappings.	**L2 & L3**
CO-3	To solve and apply the concepts of transforms in the area of engineering.	**L3 & L5**
CO-4	To solve numerically the Algebraic equations, Differential equations, and to differentiate & integrate numerically.	**L2 & L3**
CO-5	To understand and use the concept of statistical tools to analyze the different data.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Engineering Science Elective/ Mathematics-III (RESE-241-RESE-249/RTAS-241)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech ME**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Fluid Mechanics**
Course Code: RTME-241	**Title: Fluid Mechanics**

Course Objectives:

1. To make the students aware about the fundamental principles of fluid mechanics.
2. To enable the students to understand the problems of fluid mechanics and resolve those problems using the various laws of conservation.
3. To make the students such that they can analyze the energy losses and able to determine pressure drop in pipe flow problems
4. To develop the skill set so as to understand the functionality of various devices which work upon the principles of fluid mechanics
5. To enable the students to analyze the performance of various devices which work upon the principles of fluid mechanics

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction**: Fluid and continuum; Physical properties of fluids: Viscosity, Compressibility, Surface Tension, Capillarity, Vapour pressure; Cavitation; Classification of fluids including rheological classification. **Fluid Statics**: Pascal's Law; Pressure-density-height relationship; Pressure on plane surfaces; The Hydrostatic law; Total Pressure and centre of pressure; Buoyancy; Measurement of pressure by manometers ; Stability of immersed and floating bodies.	9L
II	**Laminar Flow**: Types of fluid flows, Steady and unsteady, Uniform and non-uniform, Laminar and Turbulent flows, 1-D, 2-D,and 3-D flows, Steam lines, Path lines and Steak lines, Steam tube; Equation of motion for laminar flow through pipes, Stokes law, Turbulent Flow, Equation for turbulent flow, Eddy viscosity, Mixing concept and velocity distribution in turbulent flow, Acceleration of a fluid particle along a straight and curved path, Differential and Integral form of continuity equation, Rotation, Vortices and circulation, Elementary explanation of Stream function and velocity potential, Flow net characteristics.	9L

III	**Fluid Dynamics-I**: Introduction to Naiver-Stokes equations; Euler's equation of motion along a streamline and its integration; Bernoulli's equation and its applications; Pitot tube; Flow through: Orifices, Mouthpieces, Nozzles, Notches, Wires; Free and forced vortex motion.	**9L**
IV	**Fluid Dynamics-II**: Pipe bend problems related to combined application of energy and momentum equations; Determination of coefficients of discharge; Velocity and contraction and energy loss; Equation for velocity distribution over smooth and rough surfaces; Concept of equivalent length; Branched pipes; Pipes in series and parallel; Flow in sudden expansion, contraction; Water hammer.	**9L**
V	**Boundary Layer Analysis**: Boundary layer thickness; Boundary layer over a flat plate; Laminar layer; Application of Von-Karman integral momentum equation; Turbulent boundary layer; Laminar sub-layer; Hydro-dynamically smooth and rough boundaries; Local and average friction coefficient; Total drag; Boundary layer separation and its control.	**9L**

Text Books:

1. Fox I R J., Introduction to Fluid Mechanics, Wiley and sons.
2. Hunter Rouse John, Elementary Mechanics of Fluids, Wiley and sons.
3. Bansal R K, Fluid Mechanics and Hydraulic Machines, Laxmi Publications

Reference Books:

1. Munson Bruce R, Donald F Young and Okishi T H Fundamentals of Fluid Mechanics Wiley Eastern
2. Grade.R J and Mirajgaonkar A G, Engineering Fluid Mechanics (Including Hydrualic Machines) Nemchand and Bros, Roorkee, 1983
3. Som and Biswas, Introduction to Fluid Mechanics and Machines TMH

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To acquire the basic knowledge of principles of fluid mechanics.	**L2**
CO-2	To understand the functionality of various devices which work upon the principles of fluid mechanics	**L2**
CO-3	To learn the energy losses and pressure drop in pipe flow problems	**L2**
CO-4	To solve the problems of fluid mechanics using the various laws of conservation.	**L3**

CO-5	To analyze the performance of various devices which work upon the principles of fluid mechanics	**L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Fluid Mechanics (RTME-241)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	0	1	1	1	1	0	2	2	0	1
CO-2	3	2	1	2	2	1	1	0	2	2	0	1
CO-3	3	2	1	2	2	1	2	0	2	2	0	1
CO-4	3	3	2	3	2	1	1	0	2	2	1	1
CO-5	3	3	2	3	2	1	2	0	2	2	1	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech ME**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Manufacturing Process**
Course Code: RTME -242	**Title: Manufacturing Process**

Course Objectives:

1. To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.
2. To make learners understand metal cutting Trends, Applications, Opportunities &Additive manufacturing used for this breakthrough technology.
3. Learn about metal joining and understanding the importance of metal joining technique in manufacturing industry.
4. The program covers Unconventional Machining Processes, principles, operations and process parameters.
5. By the end of the course, the learner will have a good understanding of the all-important manufacturing processes.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Conventional Manufacturing processes:** Introduction of Manufacturing processes, Evolution in Manufacturing Processes, Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses.	9L
II	**Metal cutting:** Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, cutting tool materials, cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.	9L
III	**Grinding & Super finishing: Grinding**: Grinding wheels, abrasive & bonds, cutting action. Grinding wheel specification. Grinding wheel wear - attrition wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and cylindrical grinding. Centre-less grinding. **Super finishing:** Honing, lapping and polishing.	9L

IV	**Metal Joining (Welding):** Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding: Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc. Other welding processes such as atomic hydrogen, submerged arc, electro-slag, friction welding. Soldering & Brazing. Adhesive bonding. Weld decay in HAZ.	**9L**
V	**Unconventional Machining Processes:** Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters. Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish. Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining.	**9L**

Text Books:

1. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.
2. Materials and Manufacturing by Paul Degarmo.
3. Manufacturing Processes by Kaushish, PHI.
4. Principles of Foundry Technology, Jain, MCGRAW HILL INDIA
5. 7. Production Technology by RK Jain.

Reference Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014.
2. Manufacturing Technology by P.N. Rao., MCGRAW HILL INDIA.
3. Degarmo, Black &Kohser, Materials and Processes in Manufacturing.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Students will be able to understand the different conventional and unconventional manufacturing methods employed for making different products.	**L2**
CO-2	Understanding the fundamentals of casting and rolling, traditional processes and process used in aerospace Industries.	**L2**
CO-3	Understanding fundamentals of welding and riveting, traditional processes and process used in aerospace Industries.	**L2**

CO-4	Understanding unconventional machining process, rapid prototyping and surface modification process.	**L2**
CO-5	Illustrate basic principles of working of machine tools viz. Lathe, Milling, Grinding, Drilling machines etc.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Manufacturing Process (RTME-242)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	1	1	1	1	1	0	2	2	0	1
CO-2	3	2	1	1	1	1	1	0	2	2	0	1
CO-3	3	2	1	1	1	1	1	0	2	2	0	1
CO-4	3	2	1	1	2	1	1	0	2	2	0	1
CO-5	3	2	2	2	2	1	1	0	2	2	1	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech ME**	**Year: II** **Semester: IV**
Credits: 2 **Theory: 2** **Practical: 0**	**Subject: Indian Ethos and Modern Management**
Course Code: IEMM-402	**Title: Indian Ethos and Modern Management**

Course Objectives:

1. To introduce the concept of Indian ethos and its relevance in modern managerial practices.
2. To understand and apply the philosophical insights of Chanakya in personal and professional success.
3. To explore management principles from Indian scriptures like the Mahabharata, Ramayana, Geeta, and Vedas.
4. To examine traditional Indian systems of learning and their contribution to karma, self-management, and corporate behavior.
5. To promote ethics- and value-based management practices in a globalized, culturally diverse workplace.

Nature of Paper: VAC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 0	P: 0	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Indian Ethos** Meaning, Features, Need, History, Relevance, Principles Practiced by Indian Companies, Requisites, Elements, Role of Indian Ethos in Managerial Practices, Indian Heritage in Business Management, Ethics v/s Ethos, Indian Vs Western Management.	**9L**
II	**Chankaya's Philosophy – A Way to Personal and Public Victory and Management** Application and Impact of Chanakya's Philosophy in Personal life, Achieving success in professional life with Chankaya, Corporate Chanakya.	**9L**
III	**Management Lessons from Indian Scriptures-I** Management Lessons from Mahabharata, Management lessons from Geeta, Management Lessons from Ramayana	**9L**
IV	**Management Lessons from Indian Scriptures–II** Management Lessons from the Vedas, Management Lessons from the Bible, and Management Lessons from the Quran	**9L**

V	**Indian Systems of Learning** Modern System of Learning: Meaning, Features, Advantages, Disadvantages. Karma: Meaning, Importance of Karma to Managers, Nishkama Karma. Laws of Karma: The Great Law, Law of Creation, Law of Humility, Law of Growth, Law of Responsibility, Law of Connection. Corporate Karma: Meaning, Methodology, Guidelines for Good Corporate Karma. Self-management: Personal Growth and Lessons from Ancient Indian Education System	**9L**
VI	Relevance of Value-based& Ethics Based Management in Global Change Developing Code of Cult ure in Organization, Ethical, and Value-Based Leadership, the impact of Values on stakeholders; Trans-cultural human values; Secular-Vs Spiritual values; value system in work culture.	**9L**

Textbooks :-

1. Gaur, R. R., Sangal, R., & Bagaria, G. P. (2010). *A Foundation Course in Human Values and Professional Ethics*. New Delhi: Excel Books.
2. Gupta, R. (2011). *Indian Ethos and Values in Management*. New Delhi: Tata McGraw Hill Education.

Reference Books

1. Pillai, R. (2010). *Corporate Chanakya*. Mumbai: Jaico Publishing House.
2. Nair, R. R. (2013). *Ethics in Management: Insights from Ancient Indian Wisdom*. New Delhi: Ane Books.
3. Sharma, S. K. (2014). *Management and Business Ethics*. New Delhi: I.K. International Publishing House.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Explain the meaning, principles, and significance of Indian ethos in comparison with Western management practices.	**L2**
CO-2	Apply Chanakya's philosophy and teachings to achieve effectiveness in personal conduct and managerial functions.	**L3**
CO-3	Interpret and extract relevant management lessons from Indian scriptures such as the Mahabharata, Geeta, Ramayana, and Vedas.	**L4**
CO-4	Demonstrate understanding of karma-based leadership, self-management, and ancient Indian educational values in organizational settings.	**L3**

CO-5	Analyze the impact of value-based and ethics-driven leadership in managing organizational culture and stakeholder relationships	**L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Indian Ethos and Modern Management (IEMM-402)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	–	–	–	–	3	–	3	–	2	–	2
CO-2	–	1	2	–	–	3	–	3	2	2	2	2
CO-3	–	2	–	–	–	2	–	3	1	2	–	2
CO-4	–	–	–	–	–	3	–	3	2	2	–	2
CO-5	–	1	–	–	–	3	2	3	2	2	2	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech ME**	**Year: II** **Semester: IV**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Fluid Mechanics Lab**
Course Code: RTME-241P	**Title: Fluid Mechanics Lab**

Course Objectives:

1. To learn the application of orifices and mouth pieces.
2. To understanding the working of orifice-meter and venturi-meter.
3. To gain knowledge about pipe friction and losses in pipe fittings and also to understand the working of pitot static tube apparatus
4. To understand the application of Reynold's apparatus with storage tank.
5. To understand the working of Impact of jet apparatus and wind Tunnel and also to study the flow behavior in a pipe bend.

Nature of Paper: Core (Practical)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of ESE & 40% of total)

L: 0	T: 0	P: 2	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
Practical-1	To determine the coefficients of discharge Cd, velocity Cv and contraction Cc of various types of orifices and mouth pieces.	**3L**
Practical-2	To calibrate venturimeter, by establishing the relationship, between flow rate and pressure difference and to find its coefficient of discharge	**3L**
Practical-3	To calibrate orifice meter, by establishing the relationship, between flow rate and pressure difference and to find its coefficient of discharge.	**3L**
Practical-4	To find friction factor of pipes of different diameter of same material.	**3L**
Practical-5	To determine the minor head loss coefficient for different pipe fittings.	**3L**
Practical-6	Pitot static tube apparatus: To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.	**3L**
Practical-7	Reynold's apparatus with storage tank. 1. To visualize different flow conditions. 2. To obtain the Reynolds number in different flow conditions.	**3L**
Practical-8	Impact of jet apparatus. To verify the momentum equation experimentally.	**3L**

Practical-9	Impact of jet apparatus. Comparison of change in the force exerted due to shape of the vane for different targets.	**3L**
Practical-10	Wind Tunnel: To study the boundary layer velocity profile and to determine boundary layer thickness and displacement thickness. Also to determine the exponent in the power law of velocity distribution.	**3L**

Text Books:

1. Manoj Kumar Rout, "Lab manual for Fluid Mechanics and Hydraulic Machines" BT University, 2008.
2. Dr. N. Kumar Swamay, "Fluid Mechanics and Machinery Laboratory manual", Charator publications

Reference Books:

1. Modi, Seth, "Fluid Mechanics. Hydraulic and Hydraulic Machines", Standard Book House, 2011.
2. Annapured dy Domodara Reddy, "Fluid Mechanics and Hydraulic Machines Lab manual", LAMBERT Academic Publications.
3. Madan Mohan Das, Mimi Das Saikia, Bhargab Mohan Das, "Hydraulics and Hydraulic Machines Textbook", PHI Learning, 1 st edition, 2013.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Practical file report	10
2) Practical viva	05
3) End semester practical exam	35
Total:	**50**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Learn the application of orifices and mouth pieces.	**L3**
CO-2	Understanding the working of orifice-meter and venturi-meter.	**L3**
CO-3	Gain knowledge about pipe friction and losses in pipe fittings and also to understand the working of pitot static tube apparatus	**L4**
CO-4	Understand the application of Reynold's apparatus with storage tank.	**L3**
CO-5	Understand the working of Impact of jet apparatus and wind Tunnel.	**L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Fluid Mechanics Lab (RTME-241P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	1	1	0	2	2	1	1
CO-2	3	3	2	3	2	1	1	0	2	2	1	1
CO-3	3	3	2	3	2	1	1	0	2	2	1	1
CO-4	3	3	2	3	2	1	1	0	2	2	1	1
CO-5	3	3	2	3	2	1	1	0	2	2	1	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech ME**	**Year: II** **Semester: IV**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Manufacturing Processes Lab**
Course Code: RTME-242P	**Title: Manufacturing Processes Lab**

Course Objectives:

1. Motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product.
2. Learner understands and visualized different manufacturing processes.
3. Learn about metal joining and understanding the importance of joining process in manufacturing industry.
4. Develop hands-on experience in manufacturing processes as one of the crucial competency gaps in manufacturing education today.
5. By the end of the course, the learner will foster the teamwork and communication skills that are highly sought by industry.

Nature of Paper: Core (Practical)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of ESE & 40% of total)

L: 0	T: 0	P: 2	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
Practical-1	Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine.	**3L**
Practical-2	Bolt (thread) making on Lathe machine.	**3L**
Practical-3	Tool grinding (to provide tool angles) on tool-grinder machine.	**3L**
Practical-4	Gear cutting on Milling machine.	**3L**
Practical-5	Machining a block on shaper machine.	**3L**
Practical-6	Finishing of a surface on surface-grinding machine.	**3L**
Practical-7	Drilling holes on drilling machine and study of twist-drill.	**3L**
Practical-8	Study of different types of tools and its angles & materials.	**3L**
Practical-9	Gas welding experiment.	**3L**
Practical-10	Arc welding experiment.	**3L**

Text Books:
1. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.
2. Materials and Manufacturing by Paul Degarmo.
3. Manufacturing Technology by P.N. Rao., MCGRAW HILL INDIA.

Reference Books:
1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)-Pearson India, 2014.
2. Degarmo, Black & Kohser, Materials and Processes in Manufacturing.
3. Production Technology by RK Jain.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Practical file report	10
2) Practical viva	05
3) End semester practical exam	35
Total:	**50**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Upon completion of this lab, students will be able to understand the different manufacturing methods employed for making different products.	**L2**
CO-2	Understand the process of manufacturing different products by implementing different manufacturing processes.	**L3**
CO-3	Students will demonstrate basic knowledge and skill in performing different practicals.	**L3**
CO-4	Students will be able to apply manufacturing process and understand functioning, operation and controlling of machine and equipment.	**L3**
CO-5	While performing different manufacturing process the learner can foster the teamwork and communication skills that are highly sought by industry.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Manufacturing Processes Lab (RTME-242P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	1	1	2	1	1	0	2	2	1	1
CO-2	3	2	2	2	3	1	1	0	2	2	1	1
CO-3	3	2	2	2	3	1	1	0	2	2	1	1
CO-4	3	2	2	2	3	1	1	0	2	2	1	1
CO-5	1	1	1	1	1	1	1	1	3	3	2	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech ME**	**Year: II** **Semester: IV**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Machine Drawing Lab**
Course Code: RTME-243P	**Title: Machine Drawing Lab**

Course Objectives:

1. To study the standard and rules to be trailed by engineers for making precise drawings.
2. To understand the fundamental dimensioning practices that must be continued in the arrangement of drawings.
3. To understand the importance of various types of joints.
4. To assist the students in the perception of assemble and sub assembly of different machine components.
5. To prepare the part drawing as per conventions.

Nature of Paper: Core (Practical)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of ESE & 40% of total)

L: 0	T: 0	P: 2	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
Practical-1	To draw the Conventional representation of materials, common machine elements and parts.	**3L**
Practical-2	To draw the Surface roughness symbols; Machining symbols, indication of surface roughness.	**3L**
Practical-3	To draw the Shaft coupling-Spigot and Socket pipe joint.	**3L**
Practical-4	To draw the popular forms of screw threads, bolts, nuts, stud bolts, tap bolts, set screws.	**3L**
Practical-5	To draw the Keys; cotter joints and knuckle joint and riveted joints for plates.	**3L**
Practical-6	To prepare the different types of limits, fits and tolerances.	**3L**
Practical-7	To prepare the part drawing of Cross heads & Eccentrics.	**3L**
Practical-8	To prepare the part drawing of Screws jacks &Tailstock.	**3L**
Practical-9	To prepare the assembly drawing of Petrol Engine connecting rod & Piston.	**3L**
Practical-10	To prepare the assembly drawing of Plummer block & stuffing boxes.	**3L**

Text Books:
1. Machine Drawing, N.D. Bhatt, Charotar Pubs.
2. Machine Drawing, Dr. R. K. Dhawan, S. Chand.
3. Machine Drawing, P.S.Gill, S.K. Kataria& Sons.

Reference Books:
1. Machine Drawing, Narayana K. L., New Age.
2. Machine Drawing, Sidheshwar, Tata McGraw-Hill.
3. Machine Drawing, R.B. Gupta, Satya Prakasham Tech. Pub.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Practical file report	10
2) Practical viva	05
3) End semester practical exam	35
Total:	**50**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Draw their ideas related to the technical aspect.	**L3**
CO-2	Acquire the knowledge materials, parts, elements and symbols used in machine drawing.	**L2**
CO-3	Draw the various types of joints used in mechanical applications	**L3**
CO-4	Prepare the part drawing as per requirement.	**L3**
CO-5	Prepare the part drawing as per conventions	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Machine Drawing Lab (RTME-243P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	3	1	3	1	1	1	2	3	1	1
CO-2	3	2	1	1	2	1	1	1	2	2	1	1
CO-3	3	2	3	1	3	1	1	1	2	3	1	1
CO-4	3	2	3	1	3	1	1	1	2	3	1	1
CO-5	3	2	3	1	3	1	1	1	2	3	1	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech ME**		**Year: II** **Semester: IV**	
Credits: 2 **Theory: 0** **Practical: 2**		**Subject: Sports**	
Course Code: SPT-PC-111		**Title: Sports**	
Course Objectives: The objectives of studying this course are 1. To develop students' physical fitness, mental well-being, and proficiency in various individual and team sports through structured participation and practice. 2. To foster qualities of discipline, teamwork, sportsmanship, and strategic thinking by engaging students in competitive and recreational games and physical activities.			
Nature of Paper: Core (Practical)			
Minimum Passing Marks/Credits: 30% of ESE & 40% of total			
L: 0	**T: 0**	**P: 2**	**C: 2**
Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)			

No	Contents	No. of Lectures Allotted
1	Archery/ Athletics/ Badminton/ Basketball/ Boxing/ Carrom/ Chess/ Cricket/ Football/ Handbal/l Judo/ Kabaddi/ Kho-Kho/ Martial Arts/ Powerlifting/ Table/ Tennis/ Volleyball/ Weightlifting/ Wrestling/ Yoga.	**2L**

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	15
2) Presentation/Seminar/Viva-Voce(Internal)		-
3) External Practical Assessment	External Assessment	35
4) Presentation/Seminar/Viva-Voce(External)		-
5) Practical Records		-
Total:		**50**

Prerequisites for the course: NA

Course Learning Outcomes:

CO-1	Demonstrate basic skills, rules, and techniques required for effective participation in individual sports such as athletics, archery, boxing, and martial arts.	**L3**
CO-2	Exhibit proficiency in team-based sports like football, basketball, volleyball, kabaddi, and kho-kho, with emphasis on coordination, communication, and team	**L3, L4**

	strategy	
CO-3	Analyze and apply rules, scoring systems, and tactics in indoor games such as chess, carrom, and table tennis to enhance cognitive and decision-making skills.	**L4**
CO-4	Develop and maintain physical fitness, flexibility, and endurance through regular practice and participation in strength-based and aerobic activities such as yoga, powerlifting, and athletics	**L3**
CO-5	Demonstrate sportsmanship, ethical behavior, self-discipline, and leadership qualities both during practice and competitive events.	**L3,L5**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Sports (SPT-PC-111)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	2	1	2	1	1	–	–	–	2	1	–	2
CO-2	–	1	2	–	–	–	–	–	3	2	2	2
CO-3	1	2	–	–	1	–	–	2	2	2	–	2
CO-4	–	–	–	2	–	–	2	–	1	1	–	3
CO-5	–	–	–	–	–	3	–	3	3	2	3	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV
Department Specific Electives-I (Offered to B.Tech IV Semester)

Program: UG(R) **Class: B.Tech ME**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Applied Thermodynamics**
Course Code: RDME-241	**Title: Applied Thermodynamics**

Course Objectives:
1. To learn about of I law for reacting systems and heating value of fuels
2. To learn about gas and vapor cycles and their first law and second law efficiencies.
3. To understand about the power plant components and steam turbines analysis
4. To learn about gas dynamics of air flow and steam through nozzles
5. To learn the about jet propulsion

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy table, **Fuels and Combustion:** Combustion analysis, heating values, air requirement, Air/Fuel ratio, standard heat of reaction and effect of temperature on standard heat of reaction, heat of formation, Adiabatic flame temperature.	**9L**
II	**Vapour Power cycles:** Vapor power cycles Rankine cycle with superheat, reheat and regeneration. Rankine cycle, effect of pressure and temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Binary vapour cycle, Combined cycles, Co-generation.	**9L**
III	**Boilers:** Classifications, working of boilers, boiler mountings, accessories, Draught, and its calculations, air pre-heater, feed water heater, super heater. Boiler efficiency, Equivalent evaporation. Boiler trial and heat balance. **Condenser:** Classification of condenser, air leakage, condenser performance parameters.	**9L**
IV	**Gas Nozzles:** Flow through Convergent and convergent-divergent nozzles, variation of velocity, area and specific volume, choked flow, throat area, Nozzle efficiency, Effect of friction on nozzle, Super	**9L**

	saturated flow. **Steam Turbines:** Classification of steam turbine, Impulse and Reaction turbines, Staging, Stage and Overall efficiency, reheat factor, Bleeding, Velocity diagram of simple and compound multistage impulse and reaction turbines and related calculations, work done, efficiencies of reaction, Impulse reaction turbines, Losses in steam turbines, Governing of turbines.	
V	**Gas Turbine:** Gas turbine classification, Brayton cycle, Principles of gas turbine, Gas turbine cycles with inter-cooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic efficiency. Deviation of actual cycles from ideal cycles. **Jet Propulsion:** Introduction to the principles of jet propulsion, Turbojet and turboprop engines and their processes, Principle of rocket propulsion, Introduction to Rocket Engine.	**9L**

Text Books:

1. Basic and Applied Thermodynamics by P.K. Nag, mcgraw hill india.
2. Applied thermodynamics by Onkar Singh, New Age International.
3. Applied Thermodynamics for Engineering Technologists by Eastop, Pearson Education
4. Applied Thermodynamics by Venkanna And Swati, PHI

Reference Books:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
4. Theory of Stream Turbine by WJ Kearton.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	The students will get a good understanding of various power cycles of gas and vapor cycles.	**L2**
CO-2	To understand different power producing machineries.	**L2**
CO-3	To understand about the power plant components and steam turbines analysis.	**L2**
CO-4	They will be able to analyze energy conversion in various thermal devices such as	**L4**

	combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors.	
CO-5	They will be able to understand phenomena occurring in high-speed compressible flows.	**L2**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Applied Thermodynamics (RDME-241)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	1	2	1	1	2	0	2	2	0	1
CO-2	3	2	1	2	1	1	1	0	2	2	0	1
CO-3	3	3	2	3	2	1	2	0	2	2	1	1
CO-4	3	3	2	3	2	1	2	0	2	2	1	1
CO-5	3	2	1	2	1	1	1	0	2	2	0	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech ME**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Operation Research**
Course Code: RDME -242	**Title: Operation Research**

Course Objectives:

1. To introduce students to the fundamental concepts and techniques of operations research for effective decision-making in engineering contexts.
2. To enable students to formulate and solve linear programming problems using graphical and simplex methods.
3. To familiarize students with transportation and assignment models to optimize resource allocation.
4. To teach network analysis techniques, such as CPM and PERT, for efficient project management.
5. To provide an understanding of inventory control and queuing theory for operational efficiency.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to Operations Research: Definition, scope, historical background, and applications in engineering. Linear Programming: Formulation of linear programming problems, graphical method for solving two-variable problems, basic feasible solutions.	**9L**
II	Linear Programming Techniques: Simplex method for solving LP problems, Big-M method for artificial variables, introduction to duality and its significance.	**9L**
III	Transportation and Assignment Problems: Transportation problem formulation, methods (Northwest Corner, Least Cost, Vogel's Approximation), assignment problem and Hungarian method for optimization.	**9L**
IV	Network Analysis: Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), project scheduling, critical path identification, and time-cost trade-offs.	**9L**
V	Inventory Control and Queuing Theory: Economic Order Quantity (EOQ) models, quantity discounts, basics of queuing theory (M/M/1 and M/M/C models), applications in operational systems.	**9L**

Text Books:

1. Hamdy A. Taha, Operations Research: An Introduction, Pearson Education, 8th Edition, 2007.
2. KantiSwarup, P.K. Gupta, Manmohan, Operations Research, S. Chand & Sons, 16th Edition, 2017.
3. Frederick S. Hillier, Gerald J. Lieberman, Introduction to Operations Research, Tata McGraw-Hill, 8th Edition, 2005

Reference Books:

1. Wayne L. Winston, Operations Research: Applications and Algorithms, Cengage Learning, 4th Edition, 2004.
2. A.M. Natarajan, P. Balasubramani, A. Tamilarasi, Operations Research, Pearson Education, 2005.
3. P. SankaraIyer, Operations Research, Tata McGraw-Hill, 2008.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the fundamental concepts and methodologies of operations research and their applications.	**L2**
CO-2	Formulate and solve linear programming problems using graphical and simplex methods.	**L3**
CO-3	Apply transportation and assignment models to optimize resource allocation in engineering problems.	**L3**
CO-4	Utilize network analysis techniques (CPM and PERT) for effective project planning and management.	**L3**
CO-5	Analyze inventory control and queuing systems to improve operational efficiency.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Operation Research (RDME-242)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	1	1	1	1	1	1	2	2	1	1
CO-2	3	3	2	2	2	1	1	1	2	2	2	1
CO-3	3	3	2	2	2	1	2	1	2	2	2	1
CO-4	3	3	2	2	2	1	1	1	2	2	3	1
CO-5	3	3	2	3	2	1	2	1	2	2	2	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech ME**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Renewable Energy Source**
Course Code: RDME -243	**Title: Renewable Energy Source**

Course Objectives:

1. To introduce students to the concept of renewable energy and its role in sustainable development.
2. To familiarize students with various renewable energy sources and their conversion technologies.
3. To understand the principles, design, and operation of solar, wind, biomass, geothermal, hydro, and ocean energy systems.
4. To analyze the environmental, economic, and social impacts of renewable energy technologies.
5. To explore the integration of renewable energy into the power grid and the role of energy storage systems.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Renewable Energy Sources:** Definition and classification of energy sources, global energy scenario, environmental impact of fossil fuels, need for renewable energy, overview of renewable energy technologies.	9L
II	**Solar Energy:** Solar radiation and measurement, solar geometry, solar thermal systems (flat plate collectors, concentrators), solar photovoltaic systems (components, working principles), applications and case studies.	9L
III	**Wind Energy:** Wind energy principles, wind turbine aerodynamics, types of wind turbines (horizontal and vertical axis), wind farm design, environmental considerations.	9L
IV	**Biomass and Geothermal Energy:** Biomass resources, conversion technologies (combustion, gasification, anaerobic digestion), geothermal energy resources, types of geothermal power plants (flash steam, binary cycle), applications and challenges.	9L
V	**Hydro, Ocean, and Energy Storage:** Hydroelectric power generation (types, environmental impact), ocean energy (tidal, wave, ocean thermal energy conversion), energy storage technologies (batteries, pumped hydro), integration of renewables into the grid.	9L

Text Books:
1. G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers.
2. S.P. Sukhatme, Solar Energy: Principles of Thermal Collection and Storage, Tata McGraw-Hill.
3. J.F. Manwell, J.G. McGowan, A.L. Rogers, Wind Energy Explained, John Wiley & Sons

Reference Books:
1. G.N. Tiwari and M.K. Ghosal, Renewable Energy Resources, Narosa Publishing House.
2. Godfrey Boyle, Renewable Energy: Power for a Sustainable Future, Oxford University Press.
3. John Twidell and Tony Weir, Renewable Energy Resources, Taylor & Francis.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the importance and classification of renewable energy sources.	**L2**
CO-2	Describe the principles and technologies of solar energy conversion.	**L2**
CO-3	Explain the concepts and systems involved in wind energy generation.	**L2**
CO-4	Understand biomass, geothermal, hydro, and ocean energy technologies.	**L2**
CO-5	Describe energy storage systems and the integration of renewables into the power grid.	**L2**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Renewable Energy Source (RDME-243)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	1	1	1	3	3	1	2	2	1	1
CO-2	3	2	2	1	2	2	2	1	2	2	1	1
CO-3	3	2	2	1	2	2	2	1	2	2	1	1
CO-4	3	2	2	1	2	2	2	1	2	2	1	1
CO-5	3	2	2	1	2	2	2	1	2	2	2	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech ME**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Supply Chain Management**
Course Code: RDME -244	**Title: Supply Chain Management**

Course Objectives:

1. To introduce students to the fundamental concepts of supply chain management and its importance in modern business.
2. To familiarize students with the key components of a supply chain, including procurement, production, distribution, and logistics.
3. To understand the role of information technology in enhancing supply chain efficiency.
4. To learn about inventory management, demand forecasting, and supply chain optimization techniques.
5. To explore case studies and real-world applications of supply chain management.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to Supply Chain Management: Definition, scope, evolution, importance in business, supply chain vs. logistics, supply chain drivers (facilities, inventory, transportation, information), performance metrics.	**9L**
II	Supply Chain Network Design: Facility location and capacity allocation, distribution network design, reverse logistics, sustainability in supply chains, case studies.	**9L**
III	Demand Forecasting and Planning: Forecasting methods (qualitative and quantitative), demand management, collaborative planning, forecasting, and replenishment (CPFR), inventory management techniques (EOQ, ABC analysis).	**9L**
IV	Logistics and Transportation: Modes of transportation (road, rail, air, sea), transportation management systems, warehouse management, third-party logistics (3PL), logistics optimization.	**9L**
V	Information Technology in SCM: Role of IT, enterprise resource planning (ERP) systems, supply chain management software, e-commerce and SCM, emerging technologies (AI, block chain).	**9L**

Text Books:

1. Supply Chain Management: Strategy, Planning, and Operation by Sunil Chopra and Peter Meindl, Pearson Education, 6th Edition, 2016.
2. Logistics and Supply Chain Management by Martin Christopher, Pearson Education, 5th Edition, 2016.
3. Introduction to Supply Chain Management by David Simchi-Levi, Philip Kaminsky, and Edith Simchi-Levi, McGraw-Hill, 2nd Edition, 2008.

Reference Books:

1. The Supply Chain Management Casebook by Sunil Chopra, FT Press, 2013.
2. Supply Chain Strategy by Edward H. Frazelle, McGraw-Hill, 2nd Edition, 2002.
3. Global Logistics and Supply Chain Management by John J. Coyle, Edward J. Bardi, and C. John Langley Jr., Cengage Learning, 10th Edition, 2016.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the basic concepts and importance of supply chain management in business operations.	**L2**
CO-2	Design and analyze supply chain networks for efficient operations.	**L3**
CO-3	Apply forecasting and inventory management techniques to optimize supply chains.	**L3**
CO-4	Manage logistics and transportation systems effectively within supply chains.	**L3**
CO-5	Utilize information technology tools to enhance supply chain efficiency.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Supply Chain Management (RDME-244)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	1	1	1	2	2	1	2	2	2	1
CO-2	3	3	3	2	2	2	2	1	2	2	2	1
CO-3	3	3	2	2	2	2	2	1	2	2	2	1
CO-4	3	2	2	2	2	2	2	1	2	2	3	1
CO-5	3	2	2	2	3	2	2	1	2	2	2	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech ME**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Introduction to Solid works**
Course Code: RDME-245	**Title: Introduction to Solid works**

Course Objectives:
The objectives of studying this course are,
1. To understand the Understand the Solid Works Interface.
2. To Create Basic 2D Sketches.
3. To Develop 3D Models from 2D Sketches.
4. To Create Assemblies.
5. To Generate Engineering Drawings.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction** Introduction to Solid Works: Solid Works interface and navigation, Sketching tools and constraints, Basic modeling techniques.	9L
II	Creating 3D Parts, Advanced sketching techniques, Extruding, revolving, and sweeping features, Fillets, chamfers, and shells, Hole creation and patterns.	9L
III	Advanced Part Modeling, Advanced feature creation (lofts, sweeps, and sweeps with guide curves), Complex sketching techniques, Design intent and parametric modeling, Configurations and design tables.	9L
IV	Assembly Design, Creating assemblies and sub-assemblies, Applying mates and constraints (Exploded views and animations, Top-down and bottom-up assembly approaches.	9L
V	Drawing and Detailing, Creating 2D drawings from 3D models, Dimensioning and annotations, Bill of Materials (BOM) creation, Assembly drawings and section views.	9L

Text Books:
1. "Engineering Design with Solid Works" by David C. Planchard and Marie P. Planchard, SDC Publications, Edition Year: 2007, ISBN: 978-1585034192.
2. "Solid Works 2021 Tutorial" by David C. Planchard and Marie P. Planchard, SDC Publications, Edition Year: 2021, ISBN: 978-163057-409-3.

Reference/Text Books:

1. "Solid Works 2021 Black Book" by Gaurav Verma and Matt Weber, Cadcamcae Works, Edition Year: 2020, ISBN: 9781774590096.
2. "Mastering Solid Works" by Matt Lombard, Sybex, Edition Year: 2018, ISBN: 978-1119300571.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO1	Apply Solid Works tools and techniques to create 3D models.	**L2**
CO2	Design and assemble complex 3D models using advanced Solid Works features.	**L2**
CO3	Generate 2D drawings and documentation from 3D models for manufacturing and assembly purposes.	**L2**
CO4	Analyze and simulate designs to evaluate their structural integrity and performance	**L2 &L3**
CO5	To generate the sectional views	**L2 &L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Introduction to Solid works (RDME-245)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	-	-	2	-	-	-	-	-	-	1
CO-2	3	2	2	2	2	-	-	-	-	-	-	1
CO-3	3	3	3	2	2	1	1	-	-	1	-	2
CO-4	3	2	2	2	1	1	1	-	-	1	-	2
CO-5	3	3	3	2	3	1	1	-	-	1	1	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B-Tech.**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Fluid Machinery**
Course Code: SEME-351	**Title: Fluid Machinery**

Course Objectives: The objectives of studying this course are,

1. To learn about the application of mass and momentum conservation laws for fluid flows
2. To understand the importance of hydraulic machineries
3. To obtain the velocity and pressure variations in various types of simple flows
4. To analyze the flow in water pumps and turbines

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 1 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Impulse of Jet and Impulse Turbines: Classification of Fluid Machines & Devices, Application of momentum and moment of momentum equation to flow through hydraulic machinery, Euler's fundamental equation. Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat &curve), Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Governing of Pelton wheel	10
II	**Reaction Turbines:** Francis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Degree of reaction, Draft tube, Cavitation in turbines, Principles of similarity, Unit and specific speed, Performance characteristics, Selection of water turbines.	10
III	**Centrifugal Pumps:** Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Cavitation & separation, Performance characteristics. Positive Displacement and other Pumps: Reciprocating pump theory, Slip, Indicator diagram, Effect of acceleration, air vessels, Comparison of centrifugal and reciprocating pumps, Performance characteristics.	10
IV	Hydraulic accumulator, Hydraulic intensifier, Hydraulic Press, hydraulic crane, hydraulic lift, hydraulic Ram, hydraulic coupling, hydraulic torque converter, air lift pump, jet pump.	10

Text Books:

1. Introduction to fluid mechanics and Fluid machines by S.K Som, Gautam Biswas, S Chakraborty
2. Fluid mechanics and machines by R.K Bansal
3. F. M. White, Fluid Mechanics, 6th Ed., Tata McGraw-Hill, 2008

Reference Books:

1. Fluid Mechanics and Its Applications by V.K. Gupta et.al
2. Fluid Mechanics by Yunus Cengel.

If the course is available as Generic Elective then the students of following departments may opt it.

1.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report Seminar On Research Project Report	20
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Outcomes:	After completing this course, student will be able to	**Level**
CO-1	Understand the basics concepts of mass and momentum conservation laws for fluid flows	**K2**
CO-2	Explain the construction and working of various components of fluid machinery systems	**K2**
CO-3	Understand the different types of fluid machinery systems with their respective applications	**K2**
CO-4	Analyze the velocity and pressure variations in various types of simple flows.	**K4**
CO-5	Account for the consequence of heat transfer in thermal analyses of engineering systems	**K2**
CO-6	Explain the interaction of fluid with machines.	**K2**

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Heat & mass transfer**
Course Code: SEME-352	**Title: Heat & mass transfer**

Course Objectives:

1. The objectives of studying this course are,
2. To understand the fundamental laws of heat transfer and apply the concepts of steady state one dimensional heat conduction.
3. To understand and apply the concept of thermal behavior of fins and transient heat conduction.
4. To understand and apply the the concepts of thermal analysis of heat exchangers.
5. To understand and apply the the concepts of thermal radiation in various engineering problems.
6. To understand and apply the the concepts forced and free convection in practical problems.

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Heat Transfer:** Thermodynamics and Heat Transfer, Modes of Heat Transfer: Conduction, convection and radiation. Effect of temperature on thermal conductivity of materials. **Conduction:** General differential heat conduction equation in the rectangular coordinates using boundary conditions. **Steady State one-dimensional Heat conduction :** Simple and Composite Systems in rectangular coordinates with and without energy generation, Concept of thermal resistance and Critical radius of insulation.	10
II	**Fins:** Heat transfer from extended surfaces, Fins of uniform cross-sectional area. **Transient Conduction:** Transient heat conduction, Lumped capacitance method, Time constant, Unsteady state heat conduction in one dimension only.	10
III	Types of heat exchangers, Fouling factors, Overall heat transfer coefficient, Logarithmic Mean Temperature Difference (LMTD) method, Effectiveness-NTU method.	10

IV	**Thermal Radiation:** Basic radiation concepts; Radiation properties of surfaces; Black body radiation, Wein's Kirchhoff's law, displacement law, Stefan Boltzmann law, Gray body, Shape factor, Radiation exchange between diffuse non-black bodies in an enclosure, Radiation shields.	10
V	**Forced Convection:** Basic concepts; Hydrodynamic boundary layer, Thermal boundary layer, Analogy between momentum and heat transfer in turbulent flow over a flat surface, Flow over a flat plate, Flow across a single cylinder and a sphere. **Natural Convection:** Physical mechanism of natural convection, Buoyant force, Empirical heat transfer relation for natural convection over planes and cylinders.	10

Text Books:

1. Heat and Mass Transfer by Cengel, McGraw-Hill.
2. A text book on Heat Transfer, by Sukhatme, University Press.
3. Heat and Mass Transfer by R Yadav, Central Publishing House.

Reference Books:

1. Fundamentals of Heat and Mass Transfer, by Incroperra & De Witt, John Wiley and Sons.
2. Heat Transfer by J.P. Holman, Mc Graw-Hill.
3. Heat Transfer by Ghoshdastidar, Oxford University Press.

If the course is available as Generic Elective then the students of following departments may opt it.

1.
2.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

Course Outcomes:	After studying the above course the student will be able,	**Level**
CO-1	Understand the fundamental laws of heat transfer and apply the concepts of steady state one dimensional heat conduction.	**K2 &K3**
CO-2	Understand and apply the concept of thermal behaviour of fins and transient heat conduction.	**K2 &K3**
CO-3	Understand and apply the concepts of thermal analysis of heat exchangers.	**K2 &K3**
CO-4	Understand and apply the concepts of thermal radiation in various engineering problems.	**K2 &K3**
CO-5	Understand and apply the concepts forced and free convection in practical problems.	**K2 &K3**
CO-6	Understand and apply the basic concepts of heat transfer	**K2 &K3**

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Production Technology**
Course Code: SEME-353	**Title: Production Technology**

Course Objectives:

1. To understand the concepts of tool geometry, tool nomenclature and various types of cutting force.
2. To analyze the cutting parameters effects on tool life and tool wear.
3. To acquire the basic knowledge of cutting fluids and machining economics and optimization.
4. To Identify the gear manufacturing and gear finishing process.
5. To understand the specifications of the grinding wheel and explain the super finishing process.

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Metal Cutting** Basic tool geometry, single point tool nomenclature, Chips- various type and their characteristics, mechanism of chip formation, Theoretical and experimental determination of shear angle. Orthogonal and oblique metal cutting. Metal cutting theories, relationship of velocities, forces and power consumption.	10
II	**Tool Life and Wear** Effect of operating parameters like tool geometry, cutting speed, feed depth of cut, coolant, materials etc. on force, temp, tool life, surface finish etc. Tool life relationship, Taylor's equation of tool life. Tool materials, flank wear, crater wear, mechanism of tool wear.	10
III	**Thermal aspects of machining:** Cutting temperature and factors affecting it, measurement, cutting fluids and its types, selection of cutting fluids. **Economics of metal machining** Elements of machining cost, tooling economics, machining economics and optimization	10
IV	**Gear Manufacturing** Classification of gear production methods, gear generation – gear hobbing, gear shaping, gear finishing methods – shaving, burnishing, grinding, lapping, honing.	10

	Hole Making Operations Introduction, Drilling, reaming, boring, tapping, other hole making operations	
V	**Grinding & Super finishing** Grinding wheels, Abrasive & bonds, Cutting action, Grinding wheel specification, Grinding wheel wear-attritions wear, fracture wear, Dressing & Turning, Max. Chip thickness & Guest criteria, Surface & Cylindrical grinding, Centre less grinding, Honing, Lapping and Polishing.	10

Text Books:

1. Production Technology (Manufacturing Processes): Manufacturing Processes, P C Sharma, S. Chand. Publishing, 2007.
2. Production Technology, R.K. Jain, Khanna Publication.
3. Manufacturing Science, Ghosh and Mallik, E.W. Press.

Reference Books:

1. Principles of Metal cutting, Sen and Bhattacharya, New central book.
2. Metal Cutting Principles, Shaw, MIT Press, Cambridge.
3. Manufacturing Technology, P.N. Rao (Vol. 2), Tata McGraw-Hill.

If the course is available as Generic Elective then the students of following departments may opt it.

1.
2.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	Understand the concepts of tool geometry, tool nomenclature and various types of cutting force.	**K2**
CO-2	Analyze the cutting parameters effects on tool life and tool wear.	**K4**
CO-3	Acquire the basic knowledge of cutting fluids and machining economics and optimization.	**K2**
CO-4	Identify the gear manufacturing and gear finishing process.	**K2**
CO-5	Understand the specifications of the grinding wheel and explain the super finishing process.	**K2**
CO-6	understand the importance of process variables controlling these processes	**K2**

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B.Tech.**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: I.C. Engine & Compressors**
Course Code: SDME-351	**Title: I.C. Engine & Compressors**

Course Objectives:

1. The objectives of studying this course are,
2. To understand fundamentals of IC engine and working principles
3. To make the students understand about the combustion phenomenon of SI and CI engines, engine pollutants
4. To teach the students on production and utilization of alternative solid, liquid and gaseous fuels
5. To teach modern trends in IC engines
6. To understand the different types of compressors and its working

Nature of Paper: DSE

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to I.C Engines:** Engine classification and basic terminology, Two and four stroke engines, SI and CI engines, Valve timing diagram, Valve mechanism- Push rod type, Overhead type (SOHC, DOHC). Thermodynamic analysis of Air standard cycles: Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles Fuel air cycle, factors affecting the fuel air cycle, Actual cycle. Testing and Performance: Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines	10
II	**Combustion:** Stages of Combustion in SI & CI engine, Factors affecting combustion, Flame speed, Ignition Delay, Abnormal combustion and its control. Combustion chamber: Squish, Swirl & tumble, Combustion chamber design for SI & CI engine & factors affecting it. Knocking and Detonations in I C engines	10
III	**Carburetion:** Mixture requirements, Carburetors and fuel injection system in SI Engine, MPFI, Scavenging in 2 Stroke engines. Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings. Turbocharging & its types- Variable Geometry Turbocharger, Waste Gate Turbocharger, Effect of turbocharging on power & emission. **Fuels**: Fuels for SI and CI engine, Important qualities of SI and CI engine	10

	fuels, Rating of SI engine and CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines.	
IV	**Ignition System in SI Engine:** Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, electronic ignition. Recent trends in IC engine: Lean burn engine, Stratified charge spark ignition engine, Homogeneous charge spark ignition engine, GDI. **Engine Emission:** Pollutant - Sources and types–Effect on environment and human health-formation of NOx-Hydrocarbon Emission Mechanism -Carbon Monoxide Formation-Particulate emissions - Methods of controlling Emissions	10
V	**Compressors:** classification, reciprocating compressors, single and multi-stage compressors, intercooling, volumetric efficiency. Rotary compressor, its classification, centrifugal compressor, Axial compressors, surging and stalling, Roots blower and Vaned blower	10

Text Books:

1. A Course in International Combustion Engines, by Mathur& Sharma, Dhanpat Rai & Sons
2. I.C Engine, by Ganeshan, Tata McGraw Hill Publishers

Reference Books:

1. I.C Engine Analysis & Practice by E.F Obert.
2. Internal Combustion Engine Fundamentals, by John B. Heywood, Tata Mcgraw Hill Publishers.
3. Engine Emission, by B. B. Pundir, Narosa Publication.
4. Engineering Fundamentals of Internal Combustion Engines by W.W. Pulkrabek, Pears.
5. Education Fundamentals of Internal Combustion Engine by Gill, Smith, Ziurs, Oxford & IBH Publishing CO. Fundamentals of Internal Combustion Engines by H.N. Gupta, Prentice Hall of India.

If the course is available as Generic Elective then the students of following departments may opt it.

1.
2.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report/Seminar On Research Project Report	20
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

Course Outcomes:	After completing this course	**Level**
CO-1	Understand the basic component and working cycle of the I.C. engine.	**K2**
CO-2	Understand the parameters that effect engine performance, combustion and knock.	**K2**
CO-3	Understand the types of fuels and injection system for SI and CI engine	**K2**
CO-4	Understand the effect of engine emissions on environment and human health and methods of reducing it.	**K4**
CO-5	Understand the working principle and types of compressors.	**K4**
CO-6	Understand the working and performance parameters of an I.C. engine.	**K2**

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B.Tech.**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: FINITE ELEMENT METHODS**
Course Code: SDME-352	**Title: FINITE ELEMENT METHODS**

Course Objectives:

1. To learn the theory and characteristics of finite elements that represent engineering structures.
2. To apply direct stiffness, Rayleigh-Ritz, Galerkin method to solve engineering problems and outline the requirements for convergence.
3. Analyze linear 1D problems like bars and trusses; 2D structural problems using CST element and analyze the axi-symmetric problems with triangular elements.
4. To apply suitable boundary conditions to a global equation for bars, trusses, beams, circular shafts, heat transfer, fluid flow, axi symmetric and dynamic problems and solve them displacements, stress and strains induced.
5. To write shape functions for 4 and 8 node quadrilateral, 6 node triangle elements and apply numerical integration to solve; 1D and 2D; stiffness integrations

Nature of Paper: DSE

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction, exact solution vs approximate solution, principle of FEM, general procedure for finite element analysis, pre-processing, solution, post processing, and various approximate methods, weighted residual method, variational or Rayleigh Ritz method, principle of minimum potential energy. Review of matrices, definition, types, addition or subtraction, multiplication, inverse of a matrix, calculus of matrix	10
II	Direct stiffness methods, linear spring as finite element, direct formulation of uni-axial bar, truss and beam elements, local and global coordinates, nodes and elements, stiffness matrix, formulation of global stiffness matrix, application of boundary conditions and forces, essential and natural boundary conditions, elimination method, penalty methods, calculation of element stresses and strains.	10
III	Finite element formulation of 1-d problems, method of weighted residuals, strong and weak form, the Galerkin finite element method, application of Galerkin's method to uni-axial bar and truss elements, Galerkin method for one dimensional heat conduction problems like heat transfer through wall, heat transfer through fin etc., one dimensional conduction with convection.	10

IV	Interpolation or shape functions, compatibility, completeness and convergence requirements, shape functions for one- and two-dimensional elements, finding shape function using Lagrange polynomials. Application of FEM in scalar field problems, heat transfer in two dimensions, time dependent heat transfer.	10
V	Concepts of plane stress and plain strain, displacement relation, stress-strain relations, equilibrium and compatibility equations, vector field problems, derivation of constant strain triangular element stiffness matrix and equations, treatment of body and surface forces, stress and strain computation. Practical considerations in finite element application, programming aspects, commercially available FEM packages, desirable features of a FEM packages, problem solving on a general purpose FEM software package like ANSYS, ABAQUS, NISA etc.	10

Text Books:

1. Fundamentals of Finite Element Analysis by David V Hutton, McGraw-Hill Learning
2. Finite Element Analysis by G L Narasaiah, BS Publications.
3. An Introduction to Finite Element Method, 3e by J N Reddy, McGraw-Hill

Reference Books:

1. Finite Element Method with Application in Engineering by Desai, Eldho and Shah, Pearson Education.
2. Introduction to Finite Element Analysis and Design by Kim & Shankar, John Wiley & Sons.
3. Introduction to Finite Elements in Engineering by Chandrupatla & Belagundu, Pearson Education.

If the course is available as Generic Elective then the students of following departments may opt it.

1.
2.

Evaluation/Assessment Methodology

	Max. Marks
6) Class tasks/ Sessional Examination	30
7) Presentations /Seminar	-
8) Assignments	-
9) Research Project Report Seminar On Research Project Report	20
10) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

Course Outcomes:	After completing this course	**Level**
CO-1	Understand the concepts behind formulation methods in FEM	**K2**
CO-2	Identify the application and characteristics of FEA elements such as bars, beams, plane and iso-parametric elements.	**K2**
CO-3	Develop element characteristic equation and generation of global equation	**K2**
CO-4	Able to apply suitable boundary conditions to a global equation for bars, trusses, beams, circular shafts, heat transfer, fluid flow, axi symmetric and dynamic problems and solve them displacements, stress and strains induced.	**K4**
CO-5	Write shape functions for 4 and 8 node quadrilateral, 6 node triangle elements and apply numerical integration to solve; 1D and 2D; stiffness integrations	**K4**

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B.Tech.**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: INDUSTRIAL ENGINEERING**
Course Code: SDME-353	**Title: INDUSTRIAL ENGINEERING**

Course Objectives:

1. To understand the basics of industrial engineering and the various types of organization structures used in industrial units.
2. To understand the sales forecasting methods and suggest the most suitable method for sales forecasting.
3. To understand the importance of production, Planning and control for better production.
4. To apply the inventory models to maintain proper stock of required material in optimum quantity.

Nature of Paper: DSE

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Industrial Engineering:** Definition, Techniques of Industrial Engineering, Origin & Development of Factory System, Pioneers of Scientific Management, Concept of Productivity. **Factory Organization:** Principles of Organization, Importance and Characteristics of Organization, Types of Organization-Military or Line Organization, Functional Organization, Line and Staff Organization, Committees Organization.	10
II	**Industrial Production Systems:** Classification of Production Systems, Introduction to Flexible Manufacturing System. **Sales Forecasting:** Introduction, Objectives and Importance of Sales Forecasting, Collective Opinion Method, Economic Indicator Method, Regression Analysis, Moving Average Method, Time Series Analysis, Break Even Analysis, **Numerical Problems.**	10
III	**Production Planning and Control:** Objectives of PPC, Functions of PPC, Preplanning and Planning, Routing, Estimating, Scheduling – Master Schedule, Daily Schedule, Gantt chart, Dispatching-Centralized v/s. Decentralized, Control and Progress Reporting. **Material Requirement Planning:** Introduction to Material Requirement Planning (MRP), Capacity Requirement Planning (CRP) Enterprise Resource Planning (ERP): Objectives and Functions.	10

IV	**Inventory Control:** Introduction, Types of Inventory, Inventory Control Importance and Functions, Inventory Costs, Factors Affecting Inventory Control, Just in Time (JIT) Manufacturing, Various Inventory Control Models, ABC Analysis, VED Analysis, Numerical Problems. **Material Handling System:** Objectives, Functions & Principle of Material Handling, Methods, Introduction to Concept of Palletization, Unit Load Concept and Automated Guided Vehicle (AGV) System.	10
V	**Product Design & Development:** Principle of product design, Tolerance design, quality & cost consideration, product life cycle, Standardization, Simplification, Diversification, Value engineering & its techniques. **Project Management:** CPM & PERT**, Numerical Problems.**	10

Text Books:

1. Industrial Engineering & Production Management, Martand T Telsang, S. Chand Publishing.
2. Industrial Engineering and Operation Research by S.K. Sharma & Savita Sharma Publication Kataria & sons.
3. Industrial Engineering & Production Management, M. Mahajan, Dhanpat Rai & **Co.**

Reference Books:

1. Production Planning and Control by S. Eilon.
2. Production and operations management by S. N. Chary Publication Tata Mc Graw Hill (TMH).
3. Modern Production Management by S. S. Buffa Publication Wiley.

If the course is available as Generic Elective then the students of following departments may opt it.

1.
2.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report Seminar On Research Project Report	20
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

Course Outcomes:	After completing this course	**Level**
CO-1	Understand the basics of industrial engineering and the various types of organization structures used in industrial units.	**K2**
CO-2	Understand the sales forecasting methods and suggest the most suitable method for sales forecasting.	**K2**
CO-3	Understand the importance of production, Planning and control for better production.	**K3**
CO-4	Apply the inventory models to maintain proper stock of required material in optimum quantity.	**K4**
CO-5	Understand the principles of product design and value engineering techniques.	**K4**

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B.Tech.**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: GAS DYNAMICS AND JET PROPULSIONG**
Course Code: SDME-354	**Title: GAS DYNAMICS AND JET PROPULSION**

Course Objectives:

1. To learn the concept of compressible fluid flow and flow through variable area ducts.
2. To learn the basic principle and types of jet and rocket propulsion.
3. Apply the fundamental basic laws for the investigation of flow through ducts.
4. Apply the basic laws for the thermodynamics analysis of jet and rocket propulsion.
5. Analyze the compressible flow through variable area ducts.

Nature of Paper: DSE

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Compressible flow, definition, Mach waves and Mach cone, stagnation states, Mass, momentum and energy equations of one-dimensional flow	10
II	Isentropic flow through variable area ducts, nozzles and diffusers, subsonic and supersonic flow variable area ducts, choked flow, Area-Mach number relations for isentropic flow	10
III	Non-isentropic flow in constant area ducts, Rayleigh and Fano flows, Normal shock relations, oblique shock relations, isentropic and shock tables.	10
IV	Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines,	10
V	Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket propulsion, performance study, staging, terminal and characteristic velocity, space flights.	10

Text Books:

1. Ahmed F. El-Sayed, Aircraft Propulsion and Gas Turbine Engines, CRC Press, 2008.
2. H.S. Mukunda, “Understanding Aerospace Chemical Propulsion”, Interline Publishing, 2004.

Reference Books:

1. Hill P. and Peterson C., Mechanics & Thermodynamics of Propulsion, Addison Wesley, 1992.
2. Zucrow N. J., Aircraft and Missile Propulsion, Vol. I & II, John Wiley, 1975.

3. Sutton G.P., Rocket Propulsion Elements, John Wiley, New York, 1986

If the course is available as Generic Elective then the students of following departments may opt it.
1.
2.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report Seminar On Research Project Report	20
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

Course Outcomes:	After completing this course	**Level**
CO-1	To learn the concept of compressible fluid flow and flow through variable area ducts.	**K2**
CO-2	To learn the basic principle and types of jet and rocket propulsion.	**K1**
CO-3	Apply the fundamental basic laws for the investigation of flow through ducts.	**K3**
CO-4	Apply the basic laws for the thermodynamics analysis of jet and rocket propulsion.	**K4**
CO-5	Analyze the compressible flow through variable area ducts.	**K4**

Farmat-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Program: UG(R) **Class: B.Tech**	**Year: III** **Semester: V**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: FLUID MACHINERY - LAB**
Course Code: SEME-351P	**Title: FLUID MACHINERY - LAB**

Course Objectives:
1. To acquire the knowledge about factors affecting the efficiency of a centrifugal pump, reciprocating pump, gear oil pump.
2. Experimentally discuss about the factors related to the efficiency of Pelton wheel, Francis turbine, Kaplan turbine.
3. Understand the working principle of pumps and turbines.

Nature of Paper: CORE (Lab)

Minimum Passing Marks: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 3 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=2Credits)
Note: Practical- 2 Hrs.=1Credit (4Hrs./Week=2Credits)

Practical No.	Practical Title
Practical-1	Impact of jet of water on Vane
Practical-2	Performance test and drawing the characteristics curves of centrifugal pump
Practical-3	Conducting experiments and drawing the characteristics curves of reciprocating pump
Practical-4	Conducting experiments and drawing the characteristics curves of gear oil pump
Practical-5	Conducting experiments and drawing the characteristics curves of Pelton wheel test rig
Practical-6	Conducting experiments and drawing the characteristics curves of Francis turbine test rig
Practical-7	Conducting experiments and drawing the characteristics curves of Kaplan turbine test rig
Practical-8	Performance test of a two-stage reciprocating air compressor
Practical-9	Performance test on an air blower

Reference/Text Books:

- Manoj Kumar Rout, "Lab manual for Fluid Mechanics and Hydraulic Machines" BT University, 2008.
- Dr. N. Kumar Swamay, "Fluid Mechanics and Machinery Laboratory manual", Charator publications.
- Modi, Seth, "Fluid Mechanics. Hydraulic and Hydraulic Machines", Standard Book House, 2011.
- Annapureddy Domodara Reddy, "Fluid Mechanics and Hydraulic Machines Lab manual", LAMBERT Academic Publications.
- Madan Mohan Das, Mimi Das Saikia , Bhargab Mohan Das, "Hydraulics and Hydraulic Machines Textbook", PHI Learning, 1 st edition, 2013.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		10
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		5
5) Practical Records		5
Total:		**50**

Course Learning Outcomes:

CO-1	To acquire the knowledge about factors affecting the efficiency of a centrifugal pump, reciprocating pump, gear oil pump	**L2**
CO-2	Experimentally discuss about the factors related to the efficiency of Pelton wheel, Francis turbine, Kaplan turbine	**L2**
CO-3	Understand the working principle of pumps and turbines.	**L2**
CO-4	Having knowledge about current research topics about fluid mechanics.	**L2**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Program: UG(R) **Class: B.Tech**	**Year: III** **Semester: V**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: HEAT & MASS TRANSFER – LAB**
Course Code: SEME-352P	**Title: HEAT & MASS TRANSFER – LAB**

Course Objectives:

1. Understand the various forms of heat transfer and their applications in real life problems
2. Analyze different methods to calculate the heat transfer coefficient in various heat transfer problems
3. Analyze the theoretical knowledge and apply it in conducting experiments in the forms of heat transfer

Nature of Paper: CORE (Lab)

Minimum Passing Marks: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 3 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=2Credits)
Note: Practical- 2 Hrs.=1Credit (4Hrs./Week=2Credits)

Practical No.	Practical Title
Practical-1	Experiment on Composite plane wall.
Practical-2	Experiment on Composite cylinder wall.
Practical-3	Experiment on Critical insulation thickness.
Practical-4	Experiment on Thermal Contact Resistance.
Practical-5	Experiment on Heat transfer through fin- (natural convection).
Practical-6	Experiment on Heat transfer through tube/fin- (forced convection).
Practical-7	Experiment on Parallel flow heat exchanger.
Practical-8	Experiment on Counter flow heat exchanger

Reference/Text Books:

- Yunus A. Cengel, "Heat Transfer a Practical Approach", Tata McGraw-Hill Education, 4th Edition, 2012.
- R. C. Sachdeva, "Fundamentals of Engineering, Heat and Mass Transfer", New Age publication, 3 rd Edition, 2012
- Heat and Mass transfer by Arora & Domkundwar
- Chemical Engineers' Handbook, by Robert H. Perry / Cecil H. Chilton Publication: McGraw – Hill

Book Company (6th edition)		
Evaluation/Assessment Methodology		
Category	**Internal/External**	**Max. Marks**
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		10
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		5
5) Practical Records		5
Total:		**50**

Course Learning Outcomes:		
CO-1	To practically relate to concepts discussed in the Heat & Mass Transfer course.	**L2**
CO-2	To conduct various experiments to determine thermal conductivity and heat transfer coefficient in various materials.	**L3**
CO-3	To select appropriate materials & designs for improving effectiveness of heat transfer.	**L2**
CO-4	To conduct performance tests and thereby improve effectiveness of heat exchangers.	**L3**
CO-5	To conduct performance tests and thereby improve effectiveness of refrigeration and air conditioning systems	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Program: UG(R) **Class: B.Tech**	**Year: III** **Semester: V**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: PRODUCTION TECHNOLOGY - LAB**
Course Code: SEME-353P	**Title: PRODUCTION TECHNOLOGY - LAB**

Course Objectives:
1. To perform bolt (thread) making on lathe machine.
2. To perform the grinding operation on tool-grinder machine.
3. To understand the gear manufacturing process on milling machine.
4. To understand and differentiate among the various arc welding processes used in industry.
5. To demonstrate the various materials, welding & tools and their angles.

Nature of Paper: CORE (Lab)

Minimum Passing Marks: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 3 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=2Credits)
Note: Practical- 2 Hrs.=1Credit (4Hrs./Week=2Credits)

Practical No.	Practical Title
Practical-1	Bolt (thread) making on Lathe machine.
Practical-2	Tool grinding (to provide tool angles) on tool-grinder machine.
Practical-3	Gear cutting on milling machine.
Practical-4	Machining a block on shaper machine.
Practical-5	To prepare a weld joint using TIG/MIG welding machine.
Practical-6	Drilling holes on drilling machine and study of twist-drill.
Practical-7	Study of different types of tools and its angles & materials.
Practical-8	Gas welding experiment.

Reference/Text Books:

- Production Technology (Manufacturing Processes): Manufacturing Processes, P C Sharma, S. Chand. Publishing, 2007.
- Production Technology, R.K. Jain, Khanna Publication.
- Manufacturing Science, Ghosh and Mallik, E.W. Press.
- Principles of Metal cutting, Sen and Bhattacharya, New central book.
- Metal Cutting Principles, Shaw, MIT Press, Cambridge.

• Manufacturing Technology, P.N. Rao (Vol. 2), Tata McGraw-Hill.		
Evaluation/Assessment Methodology		
Category	**Internal/External**	**Max. Marks**
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		10
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		5
5) Practical Records		5
Total:		**50**

Course Learning Outcomes:		
CO-1	Understand the lathe machine operation for preparation-complicated jobs like thread.	**L2**
CO-2	Perform the grinding operation on tool-grinder machine.	**L3**
CO-3	Understand the gear manufacturing process on milling machine.	**L2**
CO-4	Understand and differentiate among the various arc-welding processes used in industry.	**L2**
CO5	Demonstrate the various materials, tools and their angles.	**L2**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Program: UG(R) **Class: B.Tech**	**Year: III** **Semester: V**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: INTERNSHIP**
Course Code: SEME-354P	**Title: INTERNSHIP**

Course Objectives:

1. To provide students with industry exposure in mechanical engineering applications.
2. To develop practical knowledge of mechanical systems, manufacturing processes, and industrial operations.
3. To enhance problem-solving and analytical skills by working on real-world engineering challenges.
4. To improve technical documentation, reporting, and professional communication skills.
5. To prepare students for employment by developing industry-relevant competencies.

Nature of Paper: CORE (Lab)

Minimum Passing Marks: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 2 (In Hours/Week)
Practical- 2 Hrs.=1 Credit (4Hrs./Week=2Credits)
Note: Practical- 2 Hrs.=1Credit (4Hrs./Week=2Credits)

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	30
2) Presentation/Seminar/Viva-Voce(Internal)		20
3) External Practical Assessment	External Assessment	0
4) Presentation/Seminar/Viva-Voce(External)		0
5) Practical Records		0
Total:		**50**

Course Learning Outcomes:

CO-1	Gain hands-on experience in core mechanical engineering areas like design, manufacturing, and thermal systems.	**L3**
CO-2	Develop problem-solving and critical thinking skills in industrial environments.	**L4**
CO-3	Mprove teamwork, leadership, and communication skills in an engineering setting.	**L2 & L3**
CO-4	Learn professional documentation, project reporting, and technical presentation skills.	**L2 & L3**
CO-5	Enhance employability by gaining exposure to real-world mechanical engineering challenges and solutions.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Program: UG(R) **Class: B.Tech**	**Year: III** **Semester: V**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: RESEARCH PROJECT-I**
Course Code: SEME-359P	**Title: RESEARCH PROJECT-I**

Course Objectives:

1. To introduce students to research methodologies and systematic problem-solving in mechanical engineering.
2. To develop analytical and critical thinking skills in identifying and formulating engineering problems.
3. To provide hands-on experience in conducting experiments, simulations, or theoretical modeling.
4. To enhance students' ability to interpret and analyze experimental results.
5. To improve technical documentation, report writing, and presentation skills.

Nature of Paper: CORE (Lab)

Minimum Passing Marks: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 2 (In Hours/Week)
Practical- 2 Hrs.=1 Credit (4Hrs./Week=2Credits)
Note: Practical- 2 Hrs.=1Credit (4Hrs./Week=2Credits)

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	30
2) Presentation/Seminar/Viva-Voce(Internal)		20
3) External Practical Assessment	External Assessment	0
4) Presentation/Seminar/Viva-Voce(External)		0
5) Practical Records		0
Total:		**50**

Course Learning Outcomes:

CO-1	Develop a research-oriented approach for solving mechanical engineering problems.	**L3**
CO-2	Gain experience in data collection, analysis, and interpretation.	**L4**
CO-3	Learn teamwork, collaboration, and effective research communication	**L2 & L3**
CO-4	Enhance technical writing and presentation skills for research dissemination.	**L2 & L3**
CO-5	Develop innovative thinking and problem-solving capabilities in engineering projects.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B-Tech.**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Theory of Machines**
Course Code: SEME-361	**Title: Theory of Machines**

Course Objectives

The objectives of studying this course are,

1. To understand the principles of kinematics and dynamics of machines.
2. To calculate the velocity and acceleration for 4-bar and slider crank mechanism
3. To develop cam profile for followers executing various types of motions
4. To apply the concept of gear, gear train and flywheel for power transmission
5. To apply dynamic force analysis for slider crank mechanism and balance rotating & reciprocating masses in machines**:**

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction, mechanisms and machines, kinematics and kinetics, types of links, kinematic pairs and their classification, types of constraint, degrees of freedom of planar mechanism, Grubler's equation, mechanisms, inversion of four bar chain, slider crank chain and double slider crank chain. **Velocity analysis:** Introduction, velocity of point in mechanism, relative velocity method, velocities in four bar mechanism, instantaneous center. **Acceleration analysis:** Introduction, acceleration of a point on a link, acceleration diagram, Corioli's component of acceleration, crank and slotted lever mechanism.	10
II	**Cams:** Introduction, classification of cams and followers, cam profiles for knife edge, roller and flat faced followers for uniform velocity, uniform acceleration. **Gears and gear trains:** Introduction, classification of gears, law of gearing, tooth forms and their comparisons, systems of gear teeth, length of path of contact, contact ratio, minimum number of teeth on gear and pinion to avoid interference, simple, compound, reverted and planetary gear trains, sun and planet gear train.	10
III	**Force analysis:** Static force analysis of mechanisms, D'Alembert's Principle, dynamics of rigid link in plane motion, dynamic force analysis of planar mechanisms, piston force and crank effort. Turning moment on crankshaft due	10

	to force on piston, Turning moment diagrams for single cylinder double acting steam engine, four stroke IC engine and multi-cylinder engines, Fluctuation of speed, Flywheel	
IV	**Balancing:** Introduction, static balance, dynamic balance, balancing of rotating masses, two plane balancing, graphical and analytical methods, balancing of reciprocating masses, balancing of single cylinder engine. **Governors:** Introduction, types of governors, characteristics of centrifugal governors, gravity controlled and spring controlled centrifugal governors, hunting of centrifugal governors, inertia governors. Effort and Power of governor	10
V	**Brakes and dynamometers:** Introduction, Law of friction and types of lubrication, types of brakes, effect of braking on rear and front wheels of a four wheeler, dynamometers, belt transmission dynamometer, torsion dynamometer, hydraulic dynamometer **Gyroscope:** Space motion of rigid bodies, angular momentum, gyroscopic couples, gyroscopic stabilization, ship stabilization, stability of four wheel and two wheel vehicles moving on curved paths.	10

Text Books:

1. Theory of Machines: S.S. Rattan, McGraw Hill
2. Theory of Mechanisms and Machines: Amitabh Ghosh and Ashok Kumar Mallik, Third Edition Affiliated East-West Press.
3. Kinematics and dynamics of machinery: R L Norton, McGraw Hill.

Reference Books:

1. Theory of Machines and Mechanisms: Joseph Edward Shigley and John Joseph Uicker, Jr. Oxford University Press
2. Theory of Machines: Thomas Bevan, CBS Publishers.
3. Kinematics and dynamics of machinery: Wilson and Sadler, Third edition

If the course is available as Generic Elective then the students of following departments may opt it.

Evaluation/Assessment Methodology	
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Outcomes:	After studying the above course the student will be able,	**Level**
CO-1	Understand the principles of kinematics and dynamics of machines.	**K2**
CO-2	Calculate the velocity and acceleration for 4-bar and slider crank mechanism	**K3**
CO-3	Develop cam profile for followers executing various types of motions	**K3**
CO-4	Apply the concept of gear, gear train and flywheel for power transmission	**K3**
CO-5	Apply dynamic force analysis for slider crank mechanism and balance rotating &reciprocating masses in machines	**K3**
CO-6	Apply the concepts of gyroscope, governors in fluctuation of load and brake & dynamometer in power transmission	**K3**

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B.Tech.**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Refrigeration & Air conditioning**
Course Code: SEME-362	**Title: Refrigeration & Air conditioning**

Course Objectives:

1. The objectives of studying this course are,
2. Learning the fundamental principles and different methods of refrigeration and air conditioning.
3. Study of various refrigeration cycles and evaluate performance using Mollier charts and/ or refrigerant property tables.
4. Comparative study of different refrigerants with respect to properties, applications and environmental issues.
5. Understand the basic air conditioning processes on psychometric charts, calculate cooling load for its applications in comfort and industrial air conditioning.
6. Study of the various equipment-operating principles, operating and safety controls employed in refrigeration air conditioning systems

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Refrigeration:** Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of Refrigeration, Refrigeration effect & C.O.P. **Air Refrigeration cycle:** Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system.	10
II	**Vapour Compression System:** Analysis of vapour compression cycle, Use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P, Effect of sub cooling of condensate & superheating of refrigerant vapour on C.O.P of the cycle, Intercooling, Cascade system.	10
III	**Vapour Absorption system;** Working Principal of vapour absorption refrigeration system, Comparison between absorption & Compression systems, Ammonia – Water vapour absorption system. **Refrigerants:** Classification of refrigerants, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants, Ozone layer depletion and global warming considerations of refrigerants. Classification of refrigerants, Desirable properties of refrigerants, Common	10

	refrigerants, Secondary refrigerants, Ozone layer depletion and global warming considerations of refrigerants.	
IV	**Air Conditioning:** Introduction to air conditioning, Psychometric properties and their definitions, Different Psychometric processes, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP).	10
V	**Refrigeration Equipment & Application:** Elementary knowledge of refrigeration & air conditioning equipments e.g. compressors, condensers, evaporators & expansion devices, Food preservation, Cold storage, Refrigerates Freezers, Ice plant, Water coolers .	10

Text Books:

1. Refrigeration and Air conditioning by C.P Arora, McGraw-Hill
2. Refrigeration and Air conditioning, by Manohar Prasad, New Age International (P) Ltd. Pub.
3. Refrigeration and Air conditioning by R.C. Arora, PHI
4. Refrigeration and Air conditioning by Stoecker & Jones. McGraw-Hill
5. Refrigeration and Air conditioning by Arora & Domkundwar. Dhanpat Rai

Reference Books:

1. Principles of Refrigeration by Roy J. Dossat. Pearson Education
2. Thermal Environment Engineering. By Kuhen, Ramsey & Thelked

If the course is available as Generic Elective then the students of following departments may opt it.

1.
2.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	
3) Assignments	20
4) Research Project Report	
Seminar On Research Project Report	
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Outcomes:	After completing this course	**Level**
CO-1	Understand the basics concepts of Refrigeration & Air-Conditioning and its working principles	**K2**
CO-2	Explain the construction and working of various components in Refrigeration & Air-Conditioning systems	**K2**
CO-3	Understand the different types of RAC systems with their respective applications	**K2**
CO-4	Apply the basic laws to the thermodynamic analysis of different processes involved in Refrigeration and Air-Conditioning	**K3**
CO-5	Apply the basic concepts to calculate the COP and other performance parameters for different RAC systems	**K3**
CO-6	Use P-h, T-S to solve refrigeration and Air conditioning design problems.	**K3**

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B.Tech.**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Mechanical vibration**
Course Code: SDME-361	**Title: Mechanical vibration**

Course Objectives:

1. Formulate mathematical models of problems in vibrations using Newton's second law or energy principles
2. Determine a complete solution to the modeled mechanical vibration problems.
3. Correlate results from the mathematical model to physical characteristics of the actual system
4. Analyze the mathematical modeling of the two degrees of freedom systems and explain about the working principle of vibration absorber.
5. Compute the natural frequencies and mode shapes of a multi degree of freedom system and explain the modal analysis of a vibrating system.

Nature of Paper: DSE

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction, Classification of Vibration Systems, Harmonic motion, Vector representation of harmonic motion, Natural frequency & response, Effects of vibration, superposition of simple harmonic motions, beats, Fourier analysis-analytical and numerical methods. Single Degree Freedom System, Equation of motion, Newton's method, D'Alembert's principle, Energy method etc., Free vibration, Natural frequency, Equivalent systems, Displacement, Velocity and acceleration, Response to an initial disturbance, Torsional vibrations, Damped vibrations, Vibrations of systems with viscous damping, Logarithmic decrement, Energy dissipation in viscous damping	10
II	Single Degree Freedom: Forced Vibration Forced vibration, Harmonic excitation with viscous damping, steady state vibrations, Forced vibrations with rotating and reciprocating unbalance, Support excitation, Vibration isolation, Transmissibility, Vibration measuring instruments, Displacement, velocity and acceleration measuring instruments.	10
III	Two Degree Freedom systems Introduction, Principal modes, Double pendulum, Torsional system with damping, Coupled system, Principle of vibration absorber, Undamped dynamic vibration absorbers, Torsional vibration absorber, Centrifugal pendulum absorbers, Vibration isolators and Dampers.	10

IV	Multi-degree Freedom system: Exact Analysis, Undamped free and forced vibrations of multi-degree freedom systems, influence coefficients, Reciprocal theorem, Torsional vibration of multi-degree rotor system, Vibration of gear system, Principal coordinates, Continuous systems- Longitudinal vibrations of bars, Torsional vibrations of circular shafts.	10
V	Multi Degree Freedom system: Numerical Analysis by Rayleigh's method, Dunkerely's, Holzer's and Stodola methods, Rayleigh-Ritz method Critical speed of shafts, Whirling of uniform shaft, Shaft with one disc with and without damping, Multi-disc shafts, Secondary critical speed.	10

Text Books:

1. Mechanical Vibrations – G. K. Groover, Jain Brothers, Roorkee.
2. Mechanical Vibrations-Theory & Practice, S Bhave, Pearson Education.
3. Mechanical Vibrations-Theory & Applications, Singhal, Katson Books

Reference Books:

1. Theory of Vibrations with Applications, Thomson&Dahleh, Pearson Education.
2. Elements of Vibration Analysis, L Meirovitch, McGraw-Hill Education.
3. Mechanical Vibrations – Tse, Morse & Hinkle
4. Mechanical Vibrations – V. Rama Murthy, Narosa Publications

If the course is available as Generic Elective then the students of following departments may opt it.

1.
2.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	Students shall gain the ability to understand the causes of vibration generation.	**K2**
CO-2	Students shall be able to identify the type of vibration occurring in a device.	**K2**
CO-3	Students shall learn the methods to reduce the vibrations	**K2**
CO-4	Analyze the mathematical modeling of the two degrees of freedom systems and explain about the working principle of vibration absorber.	**K4**
CO-5	Compute the natural frequencies and mode shapes of a multi degree of freedom system and explain the modal analysis of a vibrating system.	**K2**

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B.Tech.**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Unconventional Machining Processes**
Course Code: SDME-362	**Title: Unconventional Machining Processes**

Course Objectives:

1. Learn about various unconventional machining processes, the various process parameters and their influence on performance and their applications.
2. Understand the need and importance of non-traditional machining methods and process selection
3. Gain the knowledge to remove material by thermal evaporation, mechanical energy process.
4. Apply the knowledge to remove material by chemical and electro chemical methods.
5. Analyses various material removal applications by unconventional machining process.

Nature of Paper: DSE

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Plasma Machining:** Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries; Chemical machining principle, maskants, etchants, applications.	10
II	**Plasma Machining:** Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries; Chemical machining principle, maskants, etchants, applications.	10
III	**Plasma Machining:** Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries; Chemical machining principle, maskants, etchants, applications.	10
IV	**Plasma Machining:** Application of plasma for machining, metal removal mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries; Chemical machining principle, maskants, etchants, applications.	10
V	**Plasma Machining:** Application of plasma for machining, metal removal	10

	mechanism, process parameters, accuracy and surface finish and other applications of plasma in manufacturing industries; Chemical machining principle, maskants, etchants, applications.	

Text Books:

1. K. Jain, "Advanced Machining Processes", Allied Publishers, 1st Edition, 2013.
2. Pandey P. C., Shah H.S., "Modern Machining Processes", Tata McGraw-Hill, 1st Edition, 2013.
3. Unconventional Machining Processes by A.Shadrach, Jeya Sekaran N.Nagabhooshanam, D.Sathiyamoorthy Edurights Global.

Reference Books:

1. Bhattacherya A, "New Technology", The Institute for Engineers, 1st Edition, 1973.
2. C. Elanchezhian, B. Vijaya Ramnath, M. Vijayan, "Unconventional Machining processes", Anuradha Publication, 1st Edition, 2005.
3. M. K. Singh, "Unconventional Machining processes", New Age International Publishers, 1st Edition, 2010.

If the course is available as Generic Elective then the students of following departments may opt it.

1.
2.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	Compare non-traditional machining, classification, material applications in material removal process	**K1**
CO-2	Summarize the principle and processes of abrasive jet machining.	**K2**
CO-3	Understand the principles, processes and applications of thermal metal removal processes.	**K1**
CO-4	Identify the principles, processes and applications of EBM.	**K4**
CO-5	Understand the principles, processes and applications of Plasma Machining.	**K2**

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B.Tech.**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Machine Design**
Course Code: SDME-363	**Title: Machine Design**

Course Objectives:

1. The objectives of studying this course are,
2. Describe the fundamental terms, properties, and design concepts.
3. Prepare small elements' designs and drawings for small-scale industrial units.
4. Design the riveted joints for the boiler shell.
5. Analyze the static and dynamic loads on moving elements.
6. Explain the stress developed in IC engine parts and decide the dimensions accordingly

Nature of Paper: DSE

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Engineering Materials and Concepts of Design:** Introduction, Type of design, Necessity of design, Mechanical properties of materials, Steps in machine design, Characteristics of good designer, Factor of safety, Factors affecting factor of safety, Aesthetic consideration in design, Ergonomic consideration in design, Selection of materials, Design for Static Loads-Modes of failure, Factor of safety, Theory of failure. Design for Fluctuating Loads- Cyclic stresses, Fatigue and endurance limit, Stress concentration factor, Soderberg, Goodman & Gerber criteria.	10
II	**Design of Shaft, Key & Coupling** Shaft, Type of Shaft, Shaft Materials, Standard Size, Determination of shaft diameter (Hollow and Solid) using strength (shaft subjected to twisting moment and shaft subjected to bending moment) criterion, Types of keys, Selection of square & flat keys, Types of shaft couplings, Design of sleeve or muff coupling, flange coupling.	10
III	**Design of Riveted & Welded Joints** Rivet materials, Rivet heads, Types of riveted joints, Possible failure of riveted joints, Strength Equations and efficiency of riveted joint, Caulking & fullering, Design of lap and butt joints. Riveted joints for boiler shell according to I.B.R., Welding, Common type of welded joints, Strength of butt weld, Strength of parallel fillet weld and Strength of transverse fillet weld.	10

IV	**Design of Spring & Hydrodynamic Bearings** Introduction, Types of spring, Material of helical springs, Terms used in compression spring, Styles of end, application of spring, Close-coiled helical spring, Maximum shear stress induced for given axial load, Expression for axial deflection, Calculation for number of coils, Mean coil diameter, Spring wire diameter, Spring index, Solid length, Free length, Pitch of the coil, Design of leaf springs, Design of various hydro-dynamically lubricated bearings.	10
V	**Design of Gears (Spur & Helical) & IC Engine Parts (Cylinder & Piston):** Introduction, Advantages & disadvantages of gear drive, Terms used in gears, Selection of material, Design analyzing, Lewis equation, Dynamic tooth load, Static tooth load, Wear tooth load, Design procedure for Spur gear and Helical gear, Cylinder and cylinder liner, Bore and length of cylinder, Thickness of cylinder wall, Cylinder head, Piston, Thickness of piston head, Piston ribs & Cup, Piston rings, Piston Barrel, Piston skirt.	10

Text Books:

1. Machine Design, R.S. Khurami and J.K. Gupta, S. Chand.
2. Machine Design (SI Units), Dr. P.C. Sharma and Dr. D. K. Aggarwal, S. K Kataria & Sons.
3. Machine Design, Dr. Rajendra Karwa, Laxmi Publications, 2002

Reference Books:

1. Design of Machine Elements - Bhandari, Tata McGraw-Hill.
2. Machine Design- Maleev and Hartmann, CBS Public.
3. Machine Design – An Integrated Approach - Robert L. Norton, Prentice-Hall Inc.

If the course is available as Generic Elective then the students of following departments may opt it.

1.
2.

Evaluation/Assessment Methodology

	Max. Marks
6) Class tasks/ Sessional Examination	30
7) Presentations /Seminar	-
8) Assignments	20
9) Research Project Report Seminar On Research Project Report	-
10) ESE	100
Total:	**150**

Prerequisites for the course:

Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	Acquire the basic knowledge of material properties & concepts of machine design.	**K2**
CO-2	Understand the design process of shaft, key coupling for various kinds of loadings and their applications.	**K2**
CO-3	Understand the material and design process of springs and bearing their utility.	**K2**
CO-4	Design and examine the gear strength on the basis of various static and dynamic conditions.	**K4**
CO-5	Understand the design process of a cylinder and piston and their application for an IC engine.	**K2**
CO-6	Explain the parts of IC engine and design of gears and springs	**K2**

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B.Tech.**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Artificial Intelligence**
Course Code: SDME-364	**Title: Artificial Intelligence**

Course Objectives:

1. Make learner to understand Artificial Intelligence concept and its application in mechanical engineering
2. Learn the basic concepts include representation of knowledge and computational methods for reasoning.
3. The course will cover the history, theory, and computational methods of artificial intelligence.
4. This course will give the concept of applying deep learning and neural networks to reinforcement learning and procedural control of reasoning.
5. By the end of this course, learner will have good understanding of knowledge representation, apply concepts of Learning methods and analyse Decision Networks

Nature of Paper: DSE

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction of Artificial Intelligence, Intelligent Agents, and Behaviors of Artificial Agents, Structure of Intelligent Agents. Problem solving and state space search, Uninformed Search, Heuristic search, Best- First Search, Heuristic Functions, Constraints satisfaction problem, Iterative Improvement Algorithms. (Recommended lab practice sessions: Games as Search Problems, Alpha-Beta Pruning, State-of-the-Art Game Programs.)	10
II	Introduction to Knowledge Representation, Propositional Logic, 1st order logic-I, 1st order logic-II, Inference in First-Order Logic, Using First-Order Logic, Building a Knowledge Base, Logical Reasoning Systems; Indexing, Retrieval, and Unification, Inference in FOL-II, Answer Extraction.	10
III	Procedural control of reasoning, reasoning under uncertainty, Bayesian Networks, Decision Networks, Uncertain knowledge and reasoning, The Axioms of Probability, Bayes' Rule and Its Use, Probabilistic Reasoning Systems, Making Simple Decisions, Making Complex Decisions, Introduction to Planning, Practical Planning and Acting, Inductive Learning, Learning from Observations.	10

IV	Neural Networks: Learning in Neural Networks, How the Brain Works, Perceptron, Multilayer Feed- Forward Networks, Applications of Neural Networks, Introduction to Learning, Kinds of Learning, Supervised and Unsupervised Learning, Clustering, Reinforcement Learning. Learning a Function, Aspects of Function Learning, and Types of function learning aspects: Memory, Averaging and Generalization, Example problems based on Function Learning. Learning methods, Nearest Neighbor, Decision Trees, and Neural Networks.	10
V	Intelligent Agents, Types of Communicating Agents, A Communicating Agent, Practical Natural Language Processing: Practical Applications, Efficient Parsing, Scaling Perception: Image-Processing Operations for Early Vision, Using Vision for Manipulation and Navigation, Speech Recognition. Robotics: Tasks: What Are Robots Good For? Parts: What Are Robots Made Of? Architectures, Configuration Spaces: A Framework for Analysis, Navigation and Motion Planning	10

Text Books:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", Pearson Education
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", McGraw-Hill
3. E Charniak and D McDermott, "Introduction to Artificial Intelligence", Pearson Education

Reference Books:

1. Dan W. Patterson, "Artificial Intelligence and Expert Systems", Prentice Hall of India

If the course is available as Generic Elective then the students of following departments may opt it.

1.
2.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	Understand concepts of Artificial Intelligence	**K2**
CO-2	Solve problem by Search-I & Search-II	**K2**
CO-3	Understand Knowledge representation	**K1**
CO-4	Apply concepts of Learning methods	**K3**
CO-5	Analyse Decision Networks	**K2**

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: VI**
Credits: 3 **Theory: 3** **Practical: 0**	**Subject: Universal Human Values and Professional Ethics**
Course Code: UVE-601	**Title: Universal Human Values and Professional Ethics**

Course Objectives: The objectives of studying this course are,

1. To reinstate the rich cultural legacy and human values of which we are the custodians.
2. To focus on professional ethics which are broader indicators of desirable actions vis-à-vis undesirable actions?
3. To lay down broader guidelines of values and ethics for internal and external stakeholders.
4. To suggest operational guidelines for value-based and ethical practices in the higher educational institutions leading to implementation and monitoring.
5. To indicate the outcomes of creating a value-based and ethical culture in HEIs.
6. To suggest indicative reinforcement programme for nurturing human values and ethics in HEIs.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 3 Credits

L: 3
T: 0
P: 0(In Hours/Week)
Theory - 0
Practical- NIL

Unit	Contents	No. of Lectures Allotted
I	**Introduction - Need, Basic Guidelines, Content and Process for Value Education** Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation-as the mechanism for self-exploration, Continuous Happiness and Prosperity-A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly-A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.	09
II	**Understanding Harmony in the Human Being - Harmony in Myself** Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and	09

	Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.	
III	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship** Understanding harmony in the Family- the basic unit of human interaction, Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*; Trust (*Vishwas*) and Respect (*Samman*) as the foundational values of relationship, Understanding the meaning of *Vishwas*; Difference between intention and competence, Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): *Samadhan*, *Samridhi*, *Abhay*, *Sah-astitva*as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society (*Akhand Samaj*), Universal Order (*SarvabhaumVyawastha*)- from family to world family!.	09
IV	**Understanding Harmony in the Nature and Existence - Whole existence as Co-existence** Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.	09
V	**Implications of the above Holistic Understanding of Harmony on Professional Ethics** Natural acceptance of human values, Definitiveness of Ethical Human for Conduct, Basis Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations.	09

If the course is available as Generic Elective then the students of following departments may opt it.
Not applicable

Evaluation/Assessment Methodology

	Max. Marks
1. Class tasks/ Sessional Examination	15
2. Presentations /Seminar	-
3. Assignments	0
4. Research Project Report	-
5. Seminar On Research Project Report	-
6. ESE	35
Total:	**50**

Prerequisites for the course:

Course Learning Outcomes: After undergoing this course, the students will be able to:

1. The learning process for holistic development
2. Impeccable governance
3. Effective institutional management
4. Well laid system of rewards and chastisement
5. Institutional climate where 'rights' enjoy and 'wrongs' are discouraged.
6. Understand Harmony in the Nature and Existence

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Program: UG(R) **Class: B.Tech**	**Year: III** **Semester: VI**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: THEORY OF MACHINES -LAB**
Course Code: SEME-361 P	**Title: THEORY OF MACHINES -LAB**

Course Objectives:
1. To study the various types of links, pairs and motion mechanism
2. To demonstrate the different types of inversions.
3. To understand the approach of gear train to obtain optimum velocity ration to transmit the power.
4. To apply the concept of governors to maintain the fuel supply.
5. To analyze the balancing load in static/dynamic balancing.

Nature of Paper: CORE (Lab)

Minimum Passing Marks: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 3 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=2Credits)
Note: Practical- 2 Hrs.=1Credit (4Hrs./Week=2Credits)

Practical No.	Practical Title
Practical-1	To study various type of kinematics links and Pairs.
Practical-2	To study Whitworth quick return motion mechanism and reciprocating engine mechanism.
Practical-3	To study inversion of four bar linkage.
Practical-4	To study of inversion of single/double slider crank mechanism.
Practical-5	Experiment on gear trains.
Practical-6	Experiment on dead weight type governor.
Practical-7	Experiment on spring controlled governor.
Practical-8	Experiment on critical speed of shaft.
Practical-9	Experiment on gyroscope.
Practical-10	Experiment on static/dynamic balancing

Reference/Text Books:

- Theory of machine, R.S. Khurmi and J. K. Gupta, S. Chand.
- Theory of Machines: S S Rattan, McGraw Hill.
- Kinematics and dynamics of machinery: R L Norton, McGraw Hill.
- Theory of Mechanisms and Machines: A Ghose and A K Malik, East West Press Pvt. Ltd.
- Theory of Machines: Thomas Bevan, Pearson.
- Kinematics and dynamics of machinery: C E Wilson and J E Sadler: PEARSON.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		10
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		5
5) Practical Records		5
Total:		**50**

Course Learning Outcomes:

CO-1	Study the various types of links, pairs and motion mechanism,	**L2**
CO-2	Demonstrate the different types of inversions.	**L2**
CO-3	Understand the approach of gear train to obtain optimum velocity ration to transmit the power.	**L2**
CO-4	Apply the concept of governors to maintain the fuel supply.	**L3**
CO-5	Analyze the balancing load in static/dynamic balancing.	**L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Program: UG(R) **Class: B.Tech**	**Year: III** **Semester: VI**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: REFRIGERATION & AIR CONDITIONING LAB**
Course Code: SEME-362P	**Title: REFRIGERATION & AIR CONDITIONING LAB**

Course Objectives:

1. Lerner will understand the fundamental principles and applications of refrigeration and air conditioning system.
2. Comprehend the working principle and application of different refrigeration and air conditioning systems.
3. Lerner will dispense the properties, applications and environmental issues of different refrigerants.
4. Lerner will analysis of simple vapour compression cycles.
5. Use P-h, T-S to solve refrigeration and Air conditioning design problems.

Nature of Paper: CORE (Lab)

Minimum Passing Marks: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 3 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=2Credits)
Note: Practical- 2 Hrs.=1Credit (4Hrs./Week=2Credits)

Practical No.	Practical Title
Practical-1	To study basic components of refrigeration test rig. To study refrigeration cycle, determine of coefficient of performance of cycle & determine of tonnage capacity of refrigeration unit.
Practical-2	Study of different types of expansion devices used in refrigeration system.
Practical-3	Study of different types of evaporators used in refrigeration systems.
Practical-4	To study basic components of air-conditioning system.
Practical-5	Study of window air conditioner.
Practical-6	Study of split air conditioner.
Practical-7	Study of Hermetically sealed compressor.
Practical-8	To study different psychrometric process & chart.
Practical-9	To study works principle of steam jet refrigeration system.
Practical-10	To study the analysis of simple vapour compression cycle and explain the types of

	vapour compression cycle with T-S and P-H diagram

Reference/Text Books:

- Refrigeration and Air conditioning by C.P Arora, McGraw-Hill.
- Refrigeration and Air conditioning, by Manohar Prasad, New Age International (P) Ltd. Pub.
- Refrigeration and Air conditioning by R. C. Arora, PHI.
- *Principles of Refrigeration by Roy J. Dossat. Pearson Education.*
- *Refrigeration and Air conditioning by stoecker & amp; Jones. McGraw-Hill*
- *Refrigeration and Air conditioning by Arora& Domkundwar. Dhanpat Rai.*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		10
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		5
5) Practical Records		5
Total:		**50**

Course Learning Outcomes:

CO-1	Illustrate the fundamental principles and applications of refrigeration and air conditioning system.	**L2**
CO-2	Present the properties, applications and environmental issues of different refrigerants.	**L2**
CO-3	Understand working principle and application of different refrigeration and air conditioning systems.	**L2**
CO-4	Analysis of simple vapour compression cycles.	**L3**
CO-5	Use P-h, T-S to solve refrigeration and Air conditioning design problems.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Program: UG(R) **Class: B.Tech**	**Year: III** **Semester: VI**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: MINI PROJECT**
Course Code: SEME-363P	**Title: MINI PROJECT**

Course Objectives:

1. To encourage students to apply theoretical knowledge to solve real-world mechanical engineering problems.
2. To develop practical skills in designing, modeling, fabrication, and analysis of mechanical systems.
3. To improve students' ability to conduct experiments and analyze performance parameters.
4. To enhance teamwork, project management, and professional communication skills.
5. To prepare students for large-scale research or industrial projects by fostering innovation and creativity.

Nature of Paper: CORE (Lab)

Minimum Passing Marks: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 3 (In Hours/Week)
Practical- 2 Hrs.=1 Credit (4Hrs./Week=2Credits)
Note: Practical- 2 Hrs.=1Credit (4Hrs./Week=2Credits)

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	30
2) Presentation/Seminar/Viva-Voce(Internal)		20
3) External Practical Assessment	External Assessment	0
4) Presentation/Seminar/Viva-Voce(External)		0
5) Practical Records		0
Total:		**50**

Course Learning Outcomes:

CO-1	Apply mechanical engineering principles to design and develop a functional project.	**L3**
CO-2	Gain hands-on experience in fabrication, prototyping, and testing.	**L4**
CO-3	Develop teamwork, leadership, and project management skills.	**L2 & L3**
CO-4	Improve documentation, reporting, and presentation skills for project outcomes.	**L2 & L3**
CO5	Foster innovation and creativity in solving engineering challenges.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Program: UG(R) **Class: B.Tech**	**Year: III** **Semester: VI**
Credits: NC **Theory: NC** **Practical: NC**	**Subject: RESEARCH PROJECT-II**
Course Code: SEME-369P	**Title: RESEARCH PROJECT-II**

Course Objectives:

1. To enable students to carry out advanced research in mechanical engineering.
2. To strengthen problem-solving skills through experimental, computational, or analytical approaches.
3. To develop students' ability to conduct literature reviews and identify research gaps.
4. To enhance students' capability to design, test, and validate engineering solutions.
5. To improve technical writing, research documentation, and presentation skills for academic or industrial purposes.

Nature of Paper: ENGINEERING CORE (Lab)

Minimum Passing Marks: NC

L: 0
T: 0
P: 2 (In Hours/Week)
Practical- 2 Hrs.=1 Credit (4Hrs./Week=2Credits)
Note: Practical- 2 Hrs.=1Credit (4Hrs./Week=2Credits)

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	30
2) Presentation/Seminar/Viva-Voce (Internal)		20
3) External Practical Assessment	External Assessment	0
4) Presentation/Seminar/Viva-Voce (External)		0
5) Practical Records		0
Total:		**50**

Course Learning Outcomes:

CO-1	Conduct advanced research in a specific area of mechanical engineering.	**L3**
CO-2	Develop technical skills to design experiments, simulations, or analytical models.	**L4**
CO-3	Enhance teamwork, collaboration, and project management skills in research work.	**L2 & L3**
CO-4	Mprove technical writing and communication for research reports and presentations.	**L2 & L3**
CO-5	Apply innovative methodologies to solve engineering research problems.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Program: UG(R) **Class: B.Tech**	**Year: III** **Semester: VI**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: MOOCS (SWAYAM/NPTEL)**
Course Code: NECC-365	**Title: MOOCS (SWAYAM/NPTEL)**

Course Objectives:

1. To enhance students' knowledge through online learning platforms such as SWAYAM and NPTEL.
2. To provide flexibility in learning and enable students to gain expertise in specialized areas of mechanical engineering.
3. To encourage self-paced learning and skill development in emerging technologies and industrial trends.
4. To develop critical thinking and problem-solving skills through industry-oriented courses.
5. To improve students' technical competency and employability by integrating online certifications into their academic curriculum.

Nature of Paper: Skill Enhancement Course

Minimum Passing Marks: 40% Marks / 4 Credits (40% of Internal Assessment & 40% of External Assessment)

L: 0
T: 0
P: 3 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=2Credits)
Note: Practical- 2 Hrs.=1Credit (4Hrs./Week=2Credits)

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	30
2) Presentation/Seminar/Viva-Voce (Internal)		20
3) External Practical Assessment	External Assessment	0
4) Presentation/Seminar/Viva-Voce (External)		0
5) Practical Records		0
Total:		**50**

MOOCS (Massive Open Online courses):
A massive open online course (MOOC) is an online course aimed at unlimited participation and open access via the web. In addition to traditional course materials such as filmed lectures, readings, and problem sets, many MOOCs provide interactive courses with user forums to support community interactions among students, professors, and teaching assistants (TAs) as well as immediate feedback to quick quizzes and assignments.

Course Learning Outcomes:		
CO-1	Gain knowledge in specialized mechanical engineering domains through online learning.	**L3**
CO-2	Enhance self-learning abilities and time management skills for continuous education.	**L4**
CO-3	Develop a strong foundation in industry-oriented courses and emerging technologies.	**L2 & L3**
CO-4	Improve research, technical writing, and presentation skills through course assessments.	**L2 & L3**
CO-5	Obtain certification in recognized online courses, enhancing employability and career prospects.	**L3 & L4**
Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)		

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VII

Programme: UG(R) **Class: B.Tech.**	**Year: IV** **Semester: VII**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: COMPUTER AIDED DESIGN (CAD) / COMPUTER AIDED MANUFACTURING (CAM)**
Course Code: SEME-471	**Title: COMPUTER AIDED DESIGN (CAD) / COMPUTER AIDED MANUFACTURING (CAM)**

Course Objectives:

1. To understand the importance of CAD/CAM for industrial purpose.
2. To acquire the basic knowledge to perform transformation of 2D and 3D objects.
3. To Identify and generate the Bezier's and B-Spline curve.
4. To understand the G codes and M codes for programming on lathe and milling machine.
5. To understand the concepts of group technology and flexible manufacturing system.

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction** Introduction to CAD/CAM, Historical developments, Industrial look at CAD/CAM, CAD Engineering applications, their importance & necessity; Introduction to CIM, Basics of geometric and solid modeling, explicit, implicit, intrinsic Polar envelope and parametric equations coordinate systems.	10
II	**Transformations** Introduction, transformation of points and line, 2-D rotation, reflection, scaling and combined transformation, homogeneous coordinates, 3-D scaling, shearing, rotation, reflection and translation, combined transformations orthographic, Axonometric, Oblique and perspective projections.	10
III	**Curves** Algebraic and geometric forms, Analytical & Synthetic Curves, tangents and normal, blending functions, re-parametrization, straight lines, conics, cubic splines, bezier curves and B-spline curves; Rational curves, Non-uniform Rational curves, NURBS; Curve manipulation.	10

IV	**FUNDAMENTAL OF CNC AND PART PROGRAMING** Introduction to NC systems and CNC — Machine axis and Co-ordinate system- CNC machine tools- Principle of operation CNC- Construction features including structure and Drives and Introduction of Part Programming, types — Detailed Manual part programming on Lathe & Milling machines using G codes and M codes- Cutting Cycles, Loops, Sub program and Macros- Introduction of CAM package.	10
V	**CELLULAR MANUFACTURING AND FLEXIBLE MANUFACTURING SYSTEM (FMS)** Group Technology(GT),Part Families–Parts Classification and coding, Production flow Analysis–Cellular Manufacturing–Composite part concept–Types of Flexibility — FMS — FMS Components — FMS Application & Benefits — FMS Planning and Control — Quantitative analysis in FMS	10

Text Books:

1. Computer Aided Design, R.K. Srivastava, Umesh Publication.
2. Computer Aided Engineering Design, Anupam Saxena and Birendra Sahay, Springer
3. CAD/CAM/CIM, P. Radhakrishnan, S. Subramanyam & V. Raju. New age international publisher.

Reference Books:

1. CAD/CAM by Groover and Zimmer, Prentice Hall.
2. CAD/CAM: Theory and Practice by I. Zeid, Tata McGraw Hill.
3. Mathematical Elements for Computer Graphics by Rogers & Adams, McGraw Hill.

If the course is available as Generic Elective then the students of following departments may opt it.

1.
2.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	Understand the importance of CAD/CAM for industrial purpose.	**K2**
CO-2	Acquire the basic knowledge to perform transformation of 2D and 3D objects.	**K2**
CO-3	Identify and generate the Bezier and Spline curve.	**K2**
CO-4	Understand the G codes and M codes for programming on lathe and milling machine.	**K2**
CO-5	Understand the concepts of group technology and flexible manufacturing system.	**K2**

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VII

Program: UG(R) **Class: B.Tech**	**Year: IV** **Semester: VII**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: CAD / CAM LAB**
Course Code: SEME-471P	**Title: CAD / CAM LAB**

Course Objectives:

1. Impart fundamental knowledge to students in the latest technological topics on Computer Aided Design, Computer Aided Manufacturing and Computer Aided Engineering Analysis and to prepare them for taking up further research in the areas.
2. Learner will apprehend different command of Auto CAD for design and drafting different parts.
3. Illustrate the NC and CNC programming for different machining operations to learner on CNC machine and software.
4. Learner will discern NC and CNC program on machine interface and using software
5. Exhibit their knowledge, understanding of the engineering for grouping of parts according to Group Technology philosophy.

Nature of Paper: CORE (Lab)

Minimum Passing Marks: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 3 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=2Credits)
Note: Practical- 2 Hrs.=1Credit (4Hrs./Week=2Credits)

Practical No.	Practical Title
Practical-1	To write the program for design of machine element and running it on computer
Practical-2	To write a program for optimizing a function and running it on computer.
Practical-3	To prepare given drawing using Auto CAD commands.
Practical-4	To prepare a given machine component drawing using Auto CAD
Practical-5	To prepare the drawing of components and assemble them using Auto CAD.
Practical-6	To write a part-program for a given job for lathe and running on NC machine.
Practical-7	To write a part-program for a job for drilling operation (point-to- point) and running on NC machine.
Practical-8	To write a part program for a job for milling operation and running on NC machine.
Practical-9	To generate a part program for lathe, drilling and milling operation using software.
Practical-10	To learn the grouping of parts according to Group Technology philosophy.

Reference/Text Books:

1. Additive Manufacturing, by- Amit Bandyopadhyay, Susmita Bose, CRC Press. 4. Rapid Prototyping: Principles and Applications, by -Chee Kai Chua, Kah Fai Leong, Chu Sing Lim
2. Ibrahim Zeid - CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., Company Ltd., New Delhi.
3. P. Radhakrishnan, - CAD/CAM/CIM, New Age International (P) Ltd., New Delhi

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		10
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		5
5) Practical Records		5
Total:		**50**

Course Learning Outcomes:

CO-1	Have abilities and capabilities in developing and applying computer software and hardware to mechanical design and manufacturing fields.	**L2**
CO-2	Understand and implement different command of Auto CAD for design and drafting different parts.	**L2**
CO-3	Understand the NC and CNC programming for different machining operations.	**L2**
CO-4	Apply/develop NC and CNC program on machine interface and using software.	**L3**
CO-5	Demonstrate knowledge, understanding of the engineering for grouping of parts according to Group Technology philosophy	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VII

Program: UG(R) **Class: B.Tech**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: MINOR PROJECT**
Course Code: SEME-472P	**Title: MINOR PROJECT**

Course Objectives:

6. To encourage students to apply theoretical knowledge to solve real-world mechanical engineering problems.
7. To develop practical skills in designing, modeling, fabrication, and analysis of mechanical systems.
8. To improve students' ability to conduct experiments and analyze performance parameters.
9. To enhance teamwork, project management, and professional communication skills.
10. To prepare students for large-scale research or industrial projects by fostering innovation and creativity.

Nature of Paper: CORE (Lab)

Minimum Passing Marks: 40% Marks / 4 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 3 (In Hours/Week)
Practical- 2 Hrs.=1 Credit (4Hrs./Week=2Credits)
Note: Practical- 2 Hrs.=1Credit (4Hrs./Week=2Credits)

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	40
2) Presentation/Seminar/Viva-Voce(Internal)		60
3) External Practical Assessment	External Assessment	0
4) Presentation/Seminar/Viva-Voce(External)		0
5) Practical Records		0
Total:		**100**

Course Learning Outcomes:

CO-1	Apply mechanical engineering principles to design and develop a functional project.	**L3**
CO-2	Gain hands-on experience in fabrication, prototyping, and testing.	**L4**
CO-3	Develop teamwork, leadership, and project management skills.	**L2 & L3**
CO-4	Improve documentation, reporting, and presentation skills for project outcomes.	**L2 & L3**
CO5	Foster innovation and creativity in solving engineering challenges.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VII

Program: UG(R) **Class: B.Tech**	**Year: IV** **Semester: VII**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: INTERNSHIP**
Course Code: SEME-474P	**Title: INTERNSHIP**

Course Objectives:

1. To provide students with industry exposure in mechanical engineering applications.
2. To develop practical knowledge of mechanical systems, manufacturing processes, and industrial operations.
3. To enhance problem-solving and analytical skills by working on real-world engineering challenges.
4. To improve technical documentation, reporting, and professional communication skills.
5. To prepare students for employment by developing industry-relevant competencies.

Nature of Paper: CORE (Lab)

Minimum Passing Marks: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 2 (In Hours/Week)
Practical- 2 Hrs.=1 Credit (4Hrs./Week=2Credits)
Note: Practical- 2 Hrs.=1Credit (4Hrs./Week=2Credits)

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	30
2) Presentation/Seminar/Viva-Voce(Internal)		20
3) External Practical Assessment	External Assessment	0
4) Presentation/Seminar/Viva-Voce(External)		0
5) Practical Records		0
Total:		**50**

Course Learning Outcomes:

CO-1	Gain hands-on experience in core mechanical engineering areas like design, manufacturing, and thermal systems.	**L3**
CO-2	Develop problem-solving and critical thinking skills in industrial environments.	**L4**
CO-3	Mprove teamwork, leadership, and communication skills in an engineering setting.	**L2 & L3**
CO-4	Learn professional documentation, project reporting, and technical presentation skills.	**L2 & L3**
CO-5	Enhance employability by gaining exposure to real-world mechanical engineering challenges and solutions.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

Programme: UG(R) **Class: B.Tech.**	**Year: IV** **Semester: VIII**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: NON DESTRUCTIVE TESTING**
Course Code: SDME-481	**Title: NON DESTRUCTIVE TESTING**

Course Objectives:

1. To study and understand the various Non-Destructive Evaluation and Testing methods, theory and their industrial applications.
2. Explain Principles of selection of non-destructive Evaluation method (NDE)
3. Describe various inspection methods like Magnetic particle, Radiographic Inspection their principle, general procedure, advantages and limitations.
4. Explain Special NDT Techniques with their application in different fields.

Nature of Paper: DSE (IV)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Introduction to NDT, DT, advantages & limitations of NDT, classification of NDT methods, Comparison with DT, Terminology, Flaws and Defects. Scope of NDT. Codes, Standards and Certifications in NDT. Visual Inspection– Equipment used for visual inspection, Borescopes, Application of visual inspection tests in detecting surface defects and their interpretation, advantages & limitations of visual inspection, Visual Inspection in Welding.	10
II	**Liquid Penetrant Testing:** Principle, Scope, Testing equipment, Advantages, Limitations, types of penetrants and developers, standard testing procedure, Zyglo test, Illustrative examples and interpretation of defects. **Magnetic Particle Inspection:** Principle, Scope, Testing equipment, Advantages, Limitations, Application of MPI & standard testing procedure, DC & AC magnetization, Skin Effect, different methods to generate magnetic fields, Illustrative examples and interpretation of defects.	10
III	**Radiographic Testing:** Introduction to electromagnetic waves and radioactivity, various decays, Attenuation of electromagnetic radiations, Photoelectric effect, coherent scattering and Incoherent scattering, Beam geometry. X-ray Radiography – Principle, equipment & methodology, applications, source, types of radiations and limitations; **γ-ray Radiography:** Principle, equipment, γ-ray source & technique; Radiography Image Quality Indicators, Film Processing, advantages of γ-ray	10

	radiography over X-ray radiography. Precautions against radiation hazards.	
IV	**Ultrasonic Testing:** Introduction, Principle, Piezoelectricity and Piezoelectric Transducers, Wave propagation, Ultrasonic probes, selection of angle probes, Acoustic Impedance, Reflection and transmission coefficient, Snell's law, standard testing procedure & calibration, advantages & limitations. Data representation-A-scan, B-scan, C-scan. Applications in inspection of welded joints, castings, forgings and dimensional measurements. Introduction to TOFD & Phased Array Ultrasonic Testing.	10
V	**Special NDT Techniques: Eddy Current Inspection:** Introduction, Principle, Methods, scope, Equipment, types of probes, Sensitivity, standard testing procedure, advanced ECT methods, advantages and limitations. **Acoustic Emission Technique:** Introduction, Types of AE signal, Principle, Advantages & Limitations, Interpretation of Results, Applications. **Holography, Thermography:** Introduction, Principle, advantages, limitations and applications.	10

Text Books:

1. Non-Destructive Testing and Evaluation of Materials, by- Prasad, McGraw Hill Education.
2. Practical Non-destructive Testing, by- Baldev Raj, T. Jayakumar, M. Thavasimuthu, Woodhead Publishing.
3. Non-Destructive Testing Techniques, by- Ravi Prakash, New Age International.

Reference Books:

1. Non-destructive Testing Handbook, by Robert C. McMaster, American Society for Non-destructive.
2. Introduction to Non-destructive Testing: A Training Guide, by- Paul E. Mix, wiley.
3. Electrical and Magnetic Methods of Non-destructive Testing, by- J. Blitz, springer.

If the course is available as Generic Elective then the students of following departments may opt it.

1.
2.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	Understand the concept of destructive and Non-destructive testing methods.	**K2**
CO-2	Explain the working principle and application of die penetrant test and magnetic particle inspection.	**K2**
CO-3	Understand the working principle of eddy current inspection.	**K2**
CO-4	Apply radiographic techniques for testing.	**K2**
CO-5	Apply the principle of Ultrasonic testing and applications in medical and engineering areas.	**K2**

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

Programme: UG(R) **Class: B.Tech.**	**Year: IV** **Semester: VIII**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: FLEXIBLE MANUFACTURING SYSTEM**
Course Code: SDME-482	**Title: FLEXIBLE MANUFACTURING SYSTEM**

Course Objectives:

1. To understand the role of flexible manufacturing system in manufacturing.
2. To Acquire knowledge of FMS principle in flexible manufacturing system.
3. To understand the basic concepts of FMS layout & CMM.
4. To Acquire the basic Knowledge of material handling system used in manufacturing.
5. To Analyze the management & Production problems like planning, loading, scheduling, routing in FMS.

Nature of Paper: DSE (IV)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION** Evolution of manufacturing system, FMS, Definition, Objectives & Need, Advantages, Disadvantages & Applications, Flexibility in Pull & Push type	10
II	**PRINCIPLE** Principle of FMS: Principle of flexibility, change in manufacturing system-external change & internal change, job flexibility and machine flexibility.	10
III	**FMS LAYOUT** Layout & Their salient features, single line, dual line, loop, ladder, robot centre, salient features of processing station, Processing stations-machining center, turning center, coordinate measuring machines(CMM).	10
IV	**MATERIAL HANDLING SYSTEM** Introduction, Material handling system conveyers, Robot, Earth moving vehicles, automated guided vehicles.	10
V	**MANAGEMENT & TECHNOLOGY** Tool management, Tool magazine, Tool preset, Identification, Tool monitoring & fault detection, FMS- Configuration & routine, Production planning & Control, Scheduling & Loading.	10

Text Books:

1. Flexible Manufacturing System, H.K. Shivanand, MM Benal & V Koti, New age international publisher.
2. Flexible Manufacturing System, Reza A Maleki, Prentice Hall of Inc New Jersey, 1991
3. CAD/CAM, P. N. Rao, Mc Graw Hill.

Reference Books:

1. Automation, production systems & Computer integrated manufacturing, M.P. Groover, Prentice hall of india Pvt. Ltd. New Delhi, 2009.
2. Flexible manufacturing Cells & Systems, William W Luggen, Prentice hall of Inc New Jersey, 1991.
3. Industrial Production Management in Flexible Manufacturing Systems, Dolage DAR, Auris Publishing.

If the course is available as Generic Elective then the students of following departments may opt it.

1.
2.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	
3) Assignments	20
4) Research Project Report	
Seminar On Research Project Report	
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	Understand the role of flexible manufacturing system in manufacturing.	**K2**
CO-2	Acquire knowledge of FMS principle in flexible manufacturing system.	**K2**
CO-3	Understand the basic concepts of FMS layout & CMM.	**K1**
CO-4	Acquire the basic Knowledge of material handling system used in manufacturing.	**K2**
CO-5	Analyze the management & Production problems like planning, loading, scheduling, routing in FMS.	**K2**

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

Programme: UG(R) **Class: B.Tech.**	**Year: IV** **Semester: VIII**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: POWER PLANT ENGINEERING**
Course Code: SDME-483	**Title: POWER PLANT ENGINEERING**

Course Objectives:

1. Basic knowledge of Different types of Power Plants, site selection criteria of each one of them.
2. Understanding of Thermal Power Plant Operation, turbine governing, different types
3. of high-pressure boilers including supercritical and supercharged boilers, Fluidized bed
4. combustion systems.
5. Understanding of Power Plant Economics, Energy Storage including compressed air energy and pumped hydro etc.
6. Discussing environmental and safety aspects of power plant operation

Nature of Paper: DSE (IV)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to Power Plants Introduction to the sources of energy: conventional and non-conventional; Principal types of power plants; Present status and future trends; Carbon credits Thermal Power Plant General layout of modern thermal power plant, Review of Rankine and modified Rankine cycles, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories. Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of a steam power plant.	10
II	**Hydroelectric Power Plant** Hydro-electric plant, General arrangement of hydroelectric power plant, Plant layout, Penstock and water hammer, Specific speed and capacity calculations, Classification of hydro-plant, Low-, medium and high-head plants, Pumped storage plant, Run-off River power plant, Surge tanks. **Gas turbine power plant**: Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, combined cycle power plants, Site selection of gas turbine power plant, Integrated Gas fire based Combined Cycle (IGCC) systems. Controlling of air fuel ratio (AFR) in power	10

	plant	
III	**Nuclear Power Plants**: Classification of nuclear reactors, Thermal fission reactors and power plant and their location, Pressurized water reactor, Boiling water reactor, CANDU heavy water reactor, Gas-cooled reactor, Fast breeder reactors, Organic substance cooled reactor, Reactor control, Radiation hazards, Radioactive waste disposal, nuclear power generation in India. **Solar Power Plant**: Solar energy collectors, Photovoltaic power system, Solar central receiver system, Solar thermal energy, types of solar thermal plant, typical layout and components, solar parabolic trough plants, solar tower power plants, and solar dish power plants. Working principle of concentrating solar thermal power plant and their applications.	10
IV	**Non-Conventional Power Plants** **Geothermal energy**: Hydrothermal systems, Petro thermal systems, Hybrid geothermal fossil systems, Problems associated with geothermal conversion, **Wind energy**: Components of a wind generator, Horizontal and vertical axis wind mills, Aerodynamic considerations of wind mill design, Coefficient of performance of wind mill rotor, Availability of wind energy in India, Wind power by country. **Tidal energy:** The simple single pool tidal system, The modulated single pool tidal system, The two-pool tidal system, Ocean thermal energy conversion, Principle of working, Ocean temperature differences, The open or Claude cycle, The closed or Anderson OTEC cycle, Electricity generation from Fuel cells and city garbage	10
V	**Electrical system:** Introduction to generator and exciters, Earthing of power systems, Power and unit transformer, Circuit breakers, Protective equipment, Switch gear**.** **Power Plant Economics**: Types of loads, Effect of variable load on power plant design and operation, Methods to meet variable load, Prediction of future loads, Terminology used in power supply, Cost of electrical energy, Depreciation, Energy rates (tariffs) for electrical energy, Factors affecting economics of generation and distribution of power **Environmental Aspects of Power Station:** Environmental aspects, Different pollutants due to thermal power plant and their effect on human health, Thermal pollution of water and its control, Effluents from power plants and impact on environment, Radiation from nuclear power plant effluents, Methods of pollution mitigation and control.	10

Text Books:

1. Power Plant Engineering, by F.T. Morse, Affiliated East-West Press Pvt. Ltd.
2. Power Plant Engineering by Hedge, Pearson India
3. Power Plant Technology, by Wakil, McGraw Hill.
4. Power Plant Engineering by P.K. Nag, Tata McGraw Hill
5. Steam & Gas Turbines & Power Plant Engineering by R.Yadav, Central Pub. House

Reference Books:

1. Power Plant Engineering by Gupta, PHI India. 7. 8
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010
3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.

4. Power Plant Engineering. Mahesh Verma, Metropolitan Book Company Pvt. Ltd	
If the course is available as Generic Elective then the students of following departments may opt it. 1. 2.	
Evaluation/Assessment Methodology	
	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	Understand the different sources of power generation and their impact on environment.	**K1**
CO-2	Understand the elements of power generation using conventional and nonconventional energy sources	**K2**
CO-3	Understand the concepts of electrical systems used in power plants	**K2**
CO-4	Apply the basic concepts of thermodynamics to measure the performance of different power plants	**K2**
CO-5	Determine the performance of different sources of power plants and its efficiency.	**K2**

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

Programme: UG(R) **Class: B.Tech.**	**Year: IV** **Semester: VIII**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: AUTOMOBILE ENGINEERING**
Course Code: SDME-484	**Title: AUTOMOBILE ENGINEERING**

Course Objectives:

1. To understand basics of Automobile Engineering, conversant with drive train and transmission
2. To make the student conversant with Axles, Steering System & Tyre Wheel assembly
3. To make the student conversant with Suspension and Brake System.
4. To make the student conversant with Vehicle Performance & Safety
5. To make the student conversant with Vehicle Maintenance & Garage Practice
6. To understand the various Automobile Electrical System and latest advancement in vehicles

Nature of Paper: DSE (IV)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Basic concepts of Automobile Engineering and general configuration of an automobile, Power and Torque characteristics. Rolling, air and gradient resistance. Tractive effort. Gear Box. Gear ratio determination.	10
II	**Transmission System:** Requirements. Clutches. Torque converters. Over Drive and free wheel, Universal joint. Differential Gear Mechanism of Rear Axle. Automatic transmission, Steering and Front Axle. Castor Angle, wheel camber & Toe-in, Toe-out etc... Steering geometry. Ackerman mechanism, Understeer and Oversteer.	10
III	**Braking System:** General requirements, Road, tyre adhesion, weight transfer, braking ratio. Mechanical brakes, Hydraulic brakes. Vacuum and air brakes. Thermal aspects. Antilock braking system (ABS), electronic brake force distribution. **Chassis and Suspension System:** Loads on the frame, Strength and stiffness, independent front & rear suspension, Perpendicular arm type, Parallel arm type, Dead axle suspension system, live axis suspension system, Air suspension & shock absorbers.	10
IV	**Electrical System:** Types of starting motors, generator & regulators, lighting system, Ignition system, Horn, Battery etc. Fuel Supply System: Diesel & Petrol vehicle system such as Fuel Injection Pump, Injector & Fuel Pump, Carburetor etc. MPFI.	10

V	**Emission standards and pollution control:** Indian standards for automotive Vehicles-Bharat I and II, Euro-I and Euro-II norms, fuel Quality standards, environmental management systems for automotive vehicles, fuel additives. **Alternative Energy Sources:** Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogen fuels in automobiles, modifications needed, performance, combustion & emission characteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles, Prevention maintenance and overhauling.	10

Text Books:

1. Automobile Engineering - Kripal Singh.
2. Kirpal Singh, Automobile Engineering, 7th ed., Standard Publishers, New Delhi, 1997.
3. Automobile Engineering –Ramakrishna, PHI, India.

Reference Books:

1. Automotive Engineering- Hietner.
2. Automobile Engineering - Narang.
3. Automobile Engineering –TTTI, Pearson India
4. Automotive Mechanics- Crouse.
5. Automobile Engineering - Newton and Steeds.

If the course is available as Generic Elective then the students of following departments may opt it.

1.
2.

Evaluation/Assessment Methodology

	Max. Marks
1. Class tasks/ Sessional Examination	30
2. Presentations /Seminar	-
3. Assignments	20
4. Research Project Report	-
5. Seminar On Research Project Report	
6. ESE	100
Total:	**150**

Prerequisites for the course:

Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	Ability to identify and description of different components and system of automobile	**K1**
CO-2	Students will able to explain working principle of various parts of automobile such as Axles, Wheels and Tyres, Steering System	**K2**
CO-3	Students will able to explain working principle of various parts of automobile such Suspension and Brake System.	**K1**
CO-4	Students will able to explain working principle of various parts of automobile electrical system and norms of Vehicle Maintenance	**K1**
CO-5	Able to develop strong base for understanding of future development in automobile industry	**K2**

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VII

Program: UG(R) **Class: B.Tech**	**Year: IV** **Semester: VIII**
Credits: 10 **Theory: 0** **Practical: 2**	**Subject: MAJOR PROJECT**
Course Code: SEME-481P	**Title: MAJOR PROJECT**

Course Objectives:

1. To foster problem-solving skills by applying theoretical knowledge to real-world engineering problems through hands-on project work.
2. To develop design and development abilities, enabling students to conceptualize, plan, and implement engineering solutions using appropriate tools and techniques.
3. To promote teamwork and collaboration by encouraging students to work in groups, manage tasks, and communicate effectively.
4. To enhance technical documentation and presentation skills, including report writing and oral presentations for effective communication of project outcomes.
5. To prepare students for industry and research challenges by exposing them to project-based learning, time management, and innovation practices.

Nature of Paper: CORE (Lab)

Minimum Passing Marks: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 3 (In Hours/Week)
Practical- 2 Hrs.=1 Credit (4Hrs./Week=2Credits)
Note: Practical- 2 Hrs.=1Credit (4Hrs./Week=2Credits)

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	100
2) Presentation/Seminar/Viva-Voce(Internal)		150
3) External Practical Assessment	External Assessment	0
4) Presentation/Seminar/Viva-Voce(External)		0
5) Practical Records		0
Total:		**250**

Course Learning Outcomes:

CO-1	**Apply engineering concepts** to identify, formulate, and solve real-life technical problems using appropriate tools and techniques.	**L3**
CO-2	**Design and develop a functional prototype or model** that meets specified requirements and constraints.	**L4**
CO-3	**Demonstrate effective teamwork and project management skills**, including task	**L2 & L3**

	delegation, time management, and collaborative decision-making.	
CO-4	**Prepare and present technical documentation** including project reports, design specifications, and presentations in a professional manner.	**L2 & L3**
CO5	**Evaluate and analyze project outcomes** for efficiency, feasibility, and sustainability, while considering ethical and societal impacts.	**L3 & L4**
Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)		

Evaluation Scheme

Year: I / Semester: I

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	ENAS-111	MATHEMATICAL THINKING WITH CALCULUS AND LINEAR ALGEBRA	Th	Core-1	3	1	0	4	30	20	50	100	150
2.	ENAS-112	MODERN PHYSICS IN ENGINEERING	Th	Core -2	3	1	0	4	30	20	50	100	150
	ENAS-113	ENGINEERING CHEMISTRY											
3.	ENEE-111	ELECTRICAL & ELECTRONICS IN THE MODERN WORLD	Th	Core -3	3	1	0	4	30	20	50	100	150
	ENME-111	FUNDAMENTALS OF MECHANICAL AND MECHATRONICS SYSTEMS											
4.	ENCS-111	STRUCTURED PROGRAMMING AND PROBLEM SOLVING IN C	Th	VAC-1	3	1	0	4	30	20	50	100	150
5.	ENAS-114	PROFESSIONAL COMMUNICATION AND DIGITAL FLUENCY	Th	AECC-1	3	1	0	4	30	20	50	100	150
	ENHU -112	ENVIRONMENT, ECOLOGY AND SUSTAINABILITY		AECC-2									
6.	ENAS-112P	MODERN PHYSICS IN ENGINEERING LAB	P	LAB-1	0	0	2	1	0	15	15	35	50
	ENAS-113P	ENGINEERING CHEMISTRY LAB											
7.	ENCS-111P	PROGRAMMING WITH C LAB: HANDS ON LOGIC BUILDING	P	LAB-2	0	0	4	1	0	15	15	35	50
8.	ENAS-114P	PROFESSIONAL COMMUNICATION AND DIGITAL FLUENCY	P	LAB-3	0	0	2	1	0	15	15	35	50
	ENHU -112P	ENVIRONMENT, ECOLOGY AND SUSTAINABILITY LAB											
9.	ENEE-111P	ELECTRICAL & ELECTRONICS IN THE MODERN WORLD LAB	P	LAB-4	0	0	2	2	0	15	15	35	50
	ENME-113P	INTRODUCTION TO CNC AND 3-D PRINTER LAB		SEC-1									
10.	ENME-112P	MECHANICAL WORKSHOP LAB	P	LAB-5	0	0	2	1	0	15	15	35	50
	ENME-113P	ENGINEERING GRAPHICS & DESIGN LAB											

11.	ENPH-111	SPIRITUAL AND CULTURAL HERITAGE: INDIAN EXPERIENCE	P	AC	0	0	0	NC*	0	25*	25*	0	25*
12.	NECC -112*	UNIVERSITY SOCIAL RESPONSIBILITY - COMMUNITY OUTREACH	P	AC	0	0	0	NC*	0	25*	25*	0	25*
13.	SPT-111*	SPORTS	P	AC	0	0	0	NC*	0	50*	50*	0	50*
Total					**15**	**5**	**12**	**26**	**150**	**175**	**325**	**675**	**1000**

TH- Theory paper, P-Practical, L-Lecture, T-Tutorials, C-Credit, AECC – Ability Enhancement Compulsory Course, AC – Audit Courses, NC*-No Credit Course, CT – Class Test (Sessional Examinations), TA – Teacher's Assessment, ESE – End Semester Examinations.
University Social Responsibility& Sports - Community Outreach and Sports, Spiritual And Cultural Heritage: Indian Experience are Non-Credit Qualifying Courses. Their marks will not be added in final marks.

Note:
1. NCC is offered as General Elective.
2. **Students must earn at least one Coursera certification during the Semester**
3. **A total of 8 Credits are mandatory to earn from NPTEL Coursers during 4 years of B.Tech Program.**

Evaluation Scheme – Bachelor of Technology (EE)
Year: I / Semester: II

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	ENAS-121	APPLIED DIFFERENTIAL EQUATIONS	Th	Core-4	3	1	0	4	30	20	50	100	150
2.	ENAS-123	ENGINEERING CHEMISTRY	Th	Core-5	3	1	0	4	30	20	50	100	150
	ENAS-122	MODERN PHYSICS IN ENGINEERING											
3.	ENME-121	FUNDAMENTALS OF MECHANICAL AND MECHATRONICS SYSTEMS	Th	Core-6	3	1	0	4	30	20	50	100	150
	ENEE-121	ELECTRICAL & ELECTRONICS IN THE MODERN WORLD											
4.	ENCS-121	FUNDAMENTAL CONCEPTS AND PROBLEM SOLVING WITH PYTHON	Th	VAC-2	3	1	0	4	30	20	50	100	150
5.	ENAS-124	PROFESSIONAL COMMUNICATION AND DIGITAL FLUENCY	Th	AECC-2	3	1	0	4	30	20	50	100	150
	ENHU -112	ENVIRONMENT, ECOLOGY AND SUSTAINABILITY		AECC-1									

6.	ENAS-123P ENAS-122P	ENGINEERING CHEMISTRY LAB MODERN PHYSICS IN ENGINEERING LAB	P	LAB-6	0	0	2	1	0	15	15	35	50
7.	ENCS-121P	FUNDAMENTAL CONCEPTS AND PROBLEM SOLVING WITH PYTHON LAB	P	LAB-7	0	0	4	1	0	15	15	35	50
8.	ENAS-124P ENHU-112P	PROFESSIONAL COMMUNICATION AND DIGITAL FLUENCY LAB ENVIRONMENT, ECOLOGY AND SUSTAINABILITY LAB	P	LAB-8	0	0	2	1	0	15	15	35	50
9.	ENME-123P ENEE-121P	INTRODUCTION TO CNC AND 3-D PRINTER LAB ELECTRICAL & ELECTRONICS IN THE MODERN WORLD LAB	P	SEC-1 LAB-4	0	0	2	2	0	15	15	35	50
10.	ENME-123P ENME-122P	ENGINEERING GRAPHICS & DESIGN LAB MECHANICAL WORKSHOP LAB	P	LAB-9	0	0	2	1	0	15	15	35	50
11.	ENHW-121	HEALTH AND WELLNESS	P	AC	0	0	0	NC*	0	25*	25*	0	25*
12.	NECC-121*	INDUSTRIAL VISIT / SEMINAR ON THE REPORT OF VISIT	P	AC	0	0	0	NC*	0	25*	25*	0	25*
13.	NECC -122*	UNIVERSITY SOCIAL RESPONSIBILITY - COMMUNITY OUTREACH	P	AC	0	0	0	NC*	0	25*	25*	0	25*
14.	SPT-PC-111	SPORTS	P	LAB-10	0	0	3	2	0	15	15	35	50
Total					**15**	**5**	**18**	**30**	**150**	**205**	**355**	**745**	**1050**

TH- Theory paper, P-Practical, L-Lecture, T-Tutorials, C-Credit, AECC – Ability Enhancement Compulsory Course, AC – Audit Courses, NC*-No Credit Course, CT – Class Test (Sessional Examinations), TA – Teacher's Assessment, ESE – End Semester Examinations. University Social Responsibility - Community Outreach and Sports, Industrial Visit, Health and Wellness are Non-Credit Qualifying Courses. Their marks will not be added in final marks.

Note:

1. NCC is offered as General Elective
2. **Students must earn at least one Coursera certification during the Semester**
3. **A total of 8 Credits are mandatory to earn from NPTEL Coursers during 4 years of B.Tech Program.**

Bachelor of Technology (Electrical & Electronics Engineering/Electrical Engineering)
Year: II / Semester: III

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	RTAS-231/ RESE-231-9	Engineering Mathematics-III/ Engineering Science Electives**	Th	Core-7	3	1	0	**4**	30	20	50	100	**150**
2.	RTEE-231	Network Analysis & Synthesis	Th	Core-8	3	1	0	**4**	30	20	50	100	**150**
3.	RTEE -232	Electrical and Electronics Measurements and Instrumentation	Th	Core -9	3	1	0	**4**	30	20	50	100	**150**
4.	RTEE -233	Digital Logic Design	Th	Core -10	3	1	0	**4**	30	20	50	100	**150**
5.	RSEE-231	Introduction to MATLAB	Th	SEC-3	3	0	0	**2**	10	5	15	35	**50**
6.	RTEE -231P	Network Analysis & Synthesis Lab	P	Lab-11	0	0	2	**2**	0	15	15	35	**50**
7.	RTEE -232P	Electrical and Electronics Measurements and Instrumentation Lab	P	Lab-12	0	0	2	**2**	0	15	15	35	**50**
8.	RTEE -233P	Digital Logic Design Lab	P	Lab-13	0	0	2	**2**	0	15	15	35	**50**
9.	RTAS-232P	Integrated Communication Lab	P	AECC-3	0	0	2	**2**	0	15	15	35	**50**
10.	NECC-232*	University Social Responsibility	P	AC	*0*	*0*	*0*	*NC**	*0*	*25**	*25**	0	*25**
11.	SPT-231*	SPORTS	P	AC	*0*	*0*	*0*	*NC**	*0*	*50**	*50**	0	*50**
Total					**15**	**4**	**8**	**26**	**130**	**145**	**275**	**575**	**850**

Th- Theory, L-Lecture, T-Tutorials, P-Practical (Labs), C-Credit, CT-Class Test (Sessional), TA-Teacher's Assessment (Attendance, Assignments, Tutorials, Class Tests, Quiz etc.),ESE-End Semester Examinations, NC*-Non-Credit Course, AC-Audit Course, SEC – Skill Enhancement Course.
NECC-232*, & SPT-231* are Non-credit courses and will be evaluated on the basis of a report presented by the student of his/her industrial visits, social visits ,awareness campaigns, rallies and participation in sports activities respectively during the semester. Student needs to qualify it but the marks will not be added in total marks.

Note: NCC is offered as General Elective.

Bachelor of Technology (Electrical & Electronics Engineering/Electrical Engineering)
Year: II / Semester: IV

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	RESE-241-RESE-249 / RTAS-241	Engineering Science Electives**/ Mathematics-III	Th	Core-11	3	1	0	**4**	30	20	50	100	**150**
2.	RTEE -241	Electrical Machines Engineering- I	Th	Core-12	3	1	0	**4**	30	20	50	100	**150**

3.	RTEE -242	Linear Integrated Circuit	Th	Core-13	3	1	0	**4**	30	20	50	100	**150**
4.	IEMM-402/ ASNL-402	VAC-3	Th	VAC-3	3	0	0	**2**	**10**	**5**	**15**	**35**	**50**
5.	RDEE -241- RDEE -244	DSE-I	Th	DSE-1	3	1	0	**4**	30	20	50	100	**150**
6.		Generic Elective-I	Th	GE-1	4	0	0	**4**	30	20	50	100	**150**
7.	RTEE -241P	Electrical Machines Engineering-I Lab	P	Lab-14	0	0	2	**2**	0	15	15	35	**50**
8.	RTEE -242P	Linear Integrated Circuit Lab	P	Lab-15	0	0	2	**2**	0	15	15	35	**50**
9.	RTEE -243P	Analog Electronics Lab	P	Lab-16	0	0	2	**2**	0	15	15	35	**50**
10.	NECC-241*	Industrial Visit/ Seminar/Presentation on the report of visits	P	AC	*0*	*0*	*0*	*NC**	*0*	*25**	0	*0*	*25**
11.	NECC-242*	University Social Responsibility	P	AC	*0*	*0*	*0*	*NC**	*0*	*25**	*25**	*0*	*25**
12.	SPT-PC-111	Sports	P	Lab 17	0	0	2	2	0	15	15	35	50
Total					**19**	**4**	**8**	**30**	**160**	**165**	**325**	**675**	**1000**
13	**#Minor Certification Paper-I**				3	1	0	4	30	20	50	100	150

Th- Theory, L-Lecture, T-Tutorials, P-Practical (Labs), C-Credit, CT-Class Test (Sessional), TA-Teacher's Assessment (Attendance, Assignments, Tutorials, Class Tests, Quiz etc.),ESE-End Semester Examinations, NC*-Non-Credit Course, AC-Audit Course,
NECC-241*, NECC-242* & SPT-241* are Non-credit courses and will be evaluated on the basis of a report presented by the student of his/her industrial visits, social visits ,awareness campaigns, rallies and participation in sports activities respectively during the semester. Student needs to qualify it but the marks will not be added in total marks.

Discipline Specific Electives-1 **(Refer Page No.- 85-89)**	1. RDEE-241 –Sustainable Energy 2. RDEE-242 –EMFT 3. RDEE-243 –Smart Sensor Systems 4. RDEE-244 –Electronics Devices & Circuits
Generic Electives-1	This subject will be opted by student from other Schools of the IIMT University
General Elective	Note: NCC is offered as General Elective.

Most Important regarding Internship: A minimum of 4-5 weeks internship is to be completed during summer break & its assessment will be done in 5th Semester.

#Minor Certification will be choice based and the student choosing any minor certification course has to clear all the three papers in three semesters (IV/ V/ VI Semester).

Bachelor of Technology (Electrical & Electronics Engineering/Electrical Engineering)
Year: III / Semester: V

S. No	Course Code	Course Name	Evaluation Scheme									
			Periods			Internal Marks			External Marks		Total Marks	Credits
			L	T	P	CT	TA	IP	ET	EP		
1	SEEE-351	Control Systems	3	1	0	30	20	0	100	0	**150**	**4**
2	SEEE-352	Electrical Machines-II	3	1	0	30	20	0	100	0	**150**	**4**
3	SEEE-353	Elements of Power Systems	3	1	0	30	20	0	100	0	**150**	**4**
4	SDEE-351-SDEE-354	DSE-II	3	1	0	30	20	0	100	0	**150**	**4**
5	SEEE-351P	Control Systems Lab	0	0	3	0	0	20	0	30	**50**	**2**
6	SEEE-352P	Electrical Machines Lab-II	0	0	3	0	0	20	0	30	**50**	**2**
7	SEEE-353P	Power System Lab	0	0	3	0	0	20	0	30	**50**	**2**
8	SEEE-354P	Internship	0	0	2	0	0	50	0	0	**50**	**2**
9	SEEE-359P	Research Project-I	0	0	2	0	0	*50**	0	0	*50**	*NC**
10	NECC-352*	University Social Responsibility	*0*	*0*	*0*	*0*	*0*	*25**	*0*	*0*	*25**	*NC**
11	SPT-351*	SPORTS	*0*	*0*	*0*	*0*	*0*	*50**	*0*	*0*	*50**	*NC**
		Grand Total	**12**	**04**	**13**	**120**	**80**	**110**	**400**	**90**	**800**	**24**
		#Minor Certification Paper-II	3	1	0	30	20	0	100	0	150	4

L- Lecture, T- tutorials, P- Practical (Labs), CT- Class Test (Sessional), TA- Teacher's Assessment (Assignments, Tutorials), IP- Internal Practical, ET- External Theory, EP- external Practical, NC- Non Credit Course

*Note: SEEE-359P is noncredit course and will be evaluated on the basis of Project prepared by the students during the semester. Student needs to qualify it but the marks will not be added in total marks. NECC-352 & SPT-351 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of social visits/awareness campaigns/ awareness rallies & participation in sports activity respectively during the semester. Student needs to qualify it but the marks will not be added in total marks

Engineering Courses (Core)	Control Systems, Electrical Machines-II, Elements of Power Systems, Control Systems Lab, Electrical Machines Lab-II, Power System Lab
Discipline Specific Elective-II (Refer Page No.- 97-101)	1. SDEE-351 - Signals and Systems 2. SDEE-352 - Sustainable Energy 3. SDEE-353 - HVDC & AC Transmission 4. SDEE-354 - Power System Stability

Generic Electives-I	This subject will be opted by student from other department of the IIMT University
Research Project	Research Project I
Skill Enhancement Courses	University Social Responsibility, SPORTS, Internship

#Minor Certification will be choice based and the student choosing any minor certification course has to clear all the three papers in three semesters (IV/ V/ VI Semester).

Bachelor of Technology (Electrical & Electronics Engineering/Electrical Engineering)
Year: III / Semester: VI

S. No	Course Code	Course Name	Evaluation Scheme									
			Periods			Internal Marks			External Marks		Total Marks	Credits
			L	T	P	CT	TA	IP	ET	EP		
1	SEEE-361	Power electronics	3	1	0	30	20	0	100	0	**150**	**4**
2	SEEE-362	Microprocessor and Microcontroller	3	1	0	30	20	0	100	0	**150**	**4**
3	SDEE-361-SDEE-364	DSE-III	3	1	0	30	20	0	100	0	**150**	**4**
5	UVE-601	Universal Human Values & Professional Ethics	3	0	0	10	05	0	35	0	50	3
6	SEEE-361P	Power Electronics Lab	0	0	3	0	0	20	0	30	**50**	**2**
8	SEEE-362P	Microprocessor and Microcontroller Lab	0	0	3	0	0	20	0	30	**50**	**2**
9	SEEE-363P	Mini Project Lab	0	0	3	0	0	50	0	0	**50**	**2**
10	NECC-365	MOOCS (SWAYAM/NPTEL)	0	0	2	0	0	50	0	0	**50**	**2**
11	SEEE-369P	Research Project II	0	0	2	0	0	*50**	0	0	*50**	*NC**
12	NECC-361*	Industrial Visit/ Seminar/Presentation on the report of visits	*0*	*0*	*0*	*0*	*0*	*25**	*0*	*0*	*25**	*NC**
13	NECC-362*	University Social Responsibility	*0*	*0*	*0*	*0*	*0*	*25**	*0*	*0*	*25**	*NC**
14	SPT-361*	SPORTS	*0*	*0*	*0*	*0*	*0*	*50**	*0*	*0*	*50**	*NC**
		Grand Total	**12**	**03**	**13**	**100**	**65**	**140**	**335**	**60**	**700**	**23**
15		**#Minor Certification Paper-III**	2	0	0	30	20	0	100	0	150	2

L- Lecture, T- tutorials, P- Practical (Labs), CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), IP- Internal Practical, ET- External Theory, EP- external Practical, NC- Non Credit Course

*Note: SEEE-369P is noncredit course and will be evaluated on the basis of Project prepared by the students during the semester. Student needs to qualify it but the marks will not be added in total marks.NECC-361, NECC-362 & SPT-361 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies & participation in sports activity respectively during the semester. Student needs to qualify it but the marks will not be added in total marks

Engineering Courses (Core)	Power electronics, Microprocessor and Microcontroller, Power electronics Lab, Microprocessor and Microcontroller Lab
Discipline Specific Elective-III (Refer Page No.- 109-113)	1. SDEE-361 - Power System Analysis 2. SDEE-362 - Modern Control Systems 3. SDEE-363 - FACTS Controller 4. SDEE-364 - Electrical Machine Design
Ability Enhancement Courses	Universal Human Values & Professional Ethics is a non-credit course (Audit Course)
Research Project	Research Project II
Skill Enhancement Courses	University Social Responsibility, SPORTS, MOOCS (SWAYAM/NPTEL), Mini Project Lab

Most Important regarding Internship: A minimum of 4-5 weeks internship is to be completed during summer break & its assessment will be done in 7th Semester.

#Minor Certification will be choice based and the student choosing any minor certification course has to clear all the three papers in three semesters (IV/ V/ VI Semester).

Bachelor of Technology (Electrical & Electronics Engineering/Electrical Engineering)
Year: IV / Semester: VII

S. No	Course Code	Course Name	Evaluation Scheme								Total Marks	Credits
			Periods			Internal Marks			External Marks			
			L	T	P	CT	TA	IP	ET	EP		
1	SEEE-471	Smart Grid	3	1	0	30	20	0	100	0	**150**	**4**
2		Generic Elective-II	3	1	0	30	20	0	100	0	**150**	**4**
3	SEEE-471P	Industrial Electric Drives Lab	0	0	3	0	0	20	0	30	**50**	**2**
4	SEEE-472P	Minor Project	0	0	8	0	0	40	0	60	**100**	**4**
5	SEEE-474P	Internship	0	0	2	0	0	50	0	0	**50**	**2**
6	NECC-475	MOOCS (SWAYAM/NPTEL)	0	0	2	0	0	50	0	0	**50**	**2**
7	NECC-472*	University Social Responsibility	*0*	*0*	*0*	*0*	*0*	*25**	*0*	*0*	*25**	*NC**
8	SPT-471*	SPORTS	*0*	*0*	*0*	*0*	*0*	*50**	*0*	*0*	*50**	*NC**
		Grand Total	**06**	**02**	**15**	**60**	**40**	**160**	**200**	**90**	**550**	**18**

L- Lecture, T- tutorials, P- Practical (Labs), CT- Class Test (Sessional), TA- Teacher's Assessment (Assignments, Tutorials), IP- Internal Practical, ET- External Theory, EP- external Practical, NC- Non Credit Course

*Note: NECC-472 & SPT-471 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of social visits/awareness campaigns/ awareness rallies & participation in sports activity respectively during the semester. Student needs to qualify it but the marks will not be added in total marks

Engineering Courses (Core)	Power System Protection, Industrial Electric Drives Lab
Generic Electives-II	This subject will be opted by student from other department of the IIMT University

Skill Enhancement Courses	University Social Responsibility, SPORTS, , MOOCS (SWAYAM/NPTEL),Internship
Research Project	Minor Project

Bachelor of Technology (Electrical & Electronics Engineering/Electrical Engineering)
Year: IV / Semester: VIII

S. No	Course Code	Course Name	Evaluation Scheme									
			Periods			Internal Marks			External Marks		Total Marks	Credits
			L	T	P	CT	TA	IP	ET	EP		
1		Generic Elective-III	3	1	0	30	20	0	100	0	**150**	**4**
2	SDEE-481-SDEE484	DSE-IV	3	1	0	30	20	0	100	0	**150**	**4**
3	SEEE-481P	Major Project	0	0	20	0	0	100	0	150	**250**	**10**
		Grand Total	**06**	**02**	**20**	**60**	**40**	**100**	**200**	**150**	**550**	**18**

L- Lecture, T- tutorials, P- Practical (Labs), CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), IP- Internal Practical, ET- External Theory, EP- external Practical, NC- Non Credit Course

Generic Electives-III	This subject will be opted by student from other department of the IIMT University
Discipline Specific Elective-V (Refer Page No.- 128-132)	1.SDEE-481 - Fundamental of Electric Vehicles 2. SDEE-482 - Energy Conservation & Auditing 3. SDEE-483 - Digital Signal Processing 4. SDEE-484 - Biomedical Instrumentation
Research Project	Major Project

Format-1

Format-1

CBCS: Statement of Credit distribution (w.e.f: Session 2024-25)

College/School: School of Engineering & Technology Programme: B.Tech Duration: 8 Semester Annual/Semester: Semester							Credit range: 160-190 (Suggested by CBCS Committee)				
COURSE	**CREDIT**	**SEMESTER**	**CORE COURSE Major**	**DSE Minor**	**AECC**	**SEC**	**GE (Th 4) Interdisciplinary**	**General Elective**	**Value Added Course (VAC)**	**Industrial Training/ Survey / Research Project**	**Total Credits**
No Exit Allowed	26	I	C-1 (4 Credit) C-2 (4 Credit)+P-01(1Credit) C-3 (4 Credit)+P-02(1Credit)		AECC-1 (4Credit)+ P-04 (1Credit)	SEC-1 P-(2 Credit)		NCC	VAC-1 (4 Credit) + P-9(1Credit)		26
	28	II	C-4 (4 Credit) C-5 (4 Credit)+P-05(1Credit) C-6 (4 Credit)+P-06(2Credit) P-8 (1 Credit)		AECC-2 (4Credit)+ P-04 (1Credit)	SEC-2 P-(2 Credit)		NCC	VAC-2 (4 Credit) + P-9(1Credit)		28
Certificate in Engineering	26	III	C-07(4 Credit) C-8 (4 Credit)+P-10(2 Credit) C-9 (4 Credit)+P-11(2 Credit) C-10 (4Credit)+P-12(2 Credit)		AECC-3 (P- 2Credit)	SEC-3 (2 Credit)		NCC			26
	28	IV	C-11(4 Credit) C-12 (4 Credit)+P-13(2 Credit) C-13 (4 Credit)+P-14(2	DSE-1 (4 Credit)			GE-1 (4 Credit)	NCC	VAC-3 (2 Credit)		28

			Credit) P-15(2 Credit)								
Diploma in Engineering	26	V	C-14 (4 Credit)+P-16(2 Credit) C-15 (4 Credit)+P-17(2 Credit) C-16 (4 Credit)+P-18(2 Credit)	DSE-2 (4 Credit)		SEC-4 (2 Credit)		NCC		INT-1 (2 Credit) RP-I (NC*)	26
	20	VI	C-17 (4 Credit)+P-19(2 Credit) C-18 (4 Credit)+P-20(2 Credit)	DSE-3 (4 Credit)	AECC-4 (2 Credit)	SEC-5 (2 Credit)		NCC		RP-II(NC*)	20
B.Tech (Degree)	18	VII	C-19 (4 Credit)+P-21(2 Credit)			SEC-6 (2 Credit)	GE-2 (4 Credit)	NCC		INT-2 (2 Credit) Minor Project (4 Credit)	18
	18	VIII		DSE-4 (4 Credit)			GE-3 (4 Credit)	NCC		Major Project (10 Credit)	18
			19(Th)*4(C) = 76 04(Pr)*01(C) = 04 13(Pr)*2(C) = 26 **Total = 106**	4(Th)*4(C) =16 **Total =16**	02(Th)*04(C)=8 02(Pr)*01(C)=02 01(Pr)*02(C)=02 01(Th)*02(C)=02 **Total =14**	02(Pr)*02(C)=4 04(Th)*02(C)=8 **Total =12**	03(Th)*04(C)=12 **Total =12**		02(Th)*04(C)=8 02(Pr)*01(C)=02 01(Th)*02(C) =02 **Total =12**	2+2+4+10=18 **Total =18**	**190**

IIMT UNIVERSITY MEERUT
Transforming Education System, Transforming Lives
UGC Approved Section 2(f) & 12B
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Format-2

Format-2

IIMTU-NEP Implementation: WEF: 2024-25 (B.Tech in EEE/EE)

Program	Year	Semester (15 weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester	Prerequisite	Elective (For other faculty)
BACHELOR OF TECHNOLOGY – ELECTRICAL AND ELECTRONICS ENGINEERING	FIRST YEAR	SEMESTER -I	i) Core-1 (Th.4C)	4	5	45	Mathematical Thinking with Calculus and Linear Algebra	5		SOBST
			ii) Core-2 (Th.4C+ P.1C) iii) Lab-1 (P 1 Cr.)	4 1	5 3	45 30	Modern Physics In Engineering / Engineering Chemistry Modern Physics In Engineering Lab/ Engineering Chemistry Lab	5		SOBST
			iv) VAC-1 (Th.4 Cr.) v) Lab-2 (P 1 Cr.)	4	5	45	Structured Programming and Problem-Solving in C Programming with C Lab: Hands on Logic Building	5		
			vi) Core-3 (Th.4C)	4 1	5 3	45 30	Electrical & Electronics in the Modern World / Fundamental of Mechanical & Mechatronics Systems/ Electrical & Electronics in the Modern World Lab	5		
			vii) Lab-5 (P 1 Cr.)	1	3	30	Mechanical Workshop Lab / Engineering Graphics & Design Lab			
			viii) Audit Course	NC	-	-	Spiritual And Cultural Heritage: Indian Experience			
			ix) SEC-1(P 2C)/ Lab-4	1	3	30	Introduction to CNC and 3-D Printer Lab / Introduction to Electrical and Electronics Engineering Lab			
			x) AECC-1 (Th.4C + P.1C) AECC-2 (Th.4C + P.1C) Lab-3 (P 1 Cr.) Lab-4 (P 1 Cr.)	4 1	4 3	45 30	Professional Communication and Digital Fluency / Environment, Ecology and Sustainability Effective Engineering Communication Lab / Environment, Ecology and Sustainability Lab	5		SOAH
			xi) Audit Course	NC	-	-	Universal Social Responsibility-Community Outreach			
			xii) Audit Course	NC	-	-	Sports			

BACHELOR OF TECHNOLOGY – ELECTRICAL AND ELECTRONICS ENGINEERING	FIRST YEAR	SEMESTER - II	i) Core-4 (Th.4C)	4	5	45	Applied Differential Equations	5		SOBST
			ii) Core-5 (Th.4 C + P.1C) iii) Lab-6 (P 1 Cr.)	4 1	5 3	45 30	Engineering Chemistry/ Engineering Physics Engineering Chemistry Lab/ Engineering Physics Lab	5		SOBST
			iv) VAC-2 (Th.4 C+ P 1 C) v) Lab-7 (P 1 Cr.)	4 1	5 3	45 30	Fundamental Concepts and Problem Solving with Python Fundamental Concepts and Problem Solving with Python Lab	5		
			vi) Core-6 (Th. 4 C)	4	5	45	Fundamentals Of Mechanical and Mechatronics Systems/ Fundamental of Mechanical & Mechatronics Systems	5		
			vii) Lab-9 (P 1 Cr.)	1	3	30	Mechanical Workshop Lab / Engineering Graphics & Design Lab			
			viii) Lab-10 (P 2 Cr)	2	3	30	Sports			
			ix) SEC-1(P 2C)/ Lab-4	2	3	30	Introduction to CNC and 3-D Printer Lab/ Electrical & Electronics in the Modern World			
			x) SEC-2 (P 2 Cr.)	2	2	30	Advanced industrial training in 'C' Lab			
			xi) AECC-1 (Th.4C + P.1C) AECC-2 (Th.4C + P.1C) Lab-8 (P 1 Cr.)	4 1	4 3	45 30	Professional Communication and Digital Fluency / Environment, Ecology and Sustainability Professional Communication and Digital Fluency Lab/ Environment, Ecology and Sustainability Lab	5		SOAH
			xii) Audit Course	NC	-	-	Health and Wellness			
			xiii) Audit Course	NC	-	-	Industrial Visit / Seminar on the report of visit			
			xiv) Audit Course	NC	-	-	Universal Social Responsibility-Community Outreach			
			xv) Lab-10 (P 1 Cr.)	2	-	-	SPORTS			
Program Outcome: PO1 - PO12 [ANNEXTURE-1]							**Program Specific Outcome:** PSO1 - PSO4 [ANNEXTURE-2]			

Note: A total of 8 Credits are mandatory to earn from NPTEL/Moocs/Coursers etc during 4 years of B.Tech Program

Program me	Year	Semester (15 weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester)	Prerequisite	Elective (For other faculty)
BACHELOR OF TECHNOLOGY – ELECTRICAL AND ELECTRONICS ENGINEERING	SECOND YEAR	SEMESTER -III	i) Core-07 (Th.4C)	4	5	45	Engineering Mathematics-III/ Engineering Science Electives**	5		SOBST /SET
			ii) Core-08 (Th.4C + P.2C) Lab-11 (P 1 Cr.)	4 2	5 3	45 30	Network Analysis Network Analysis Lab	5		
			iii) Core-09 (Th.4C + P.2C) Lab-12 (P 1 Cr.)	4 2	5 3	45 30	Electrical and Electronics Measurements and Instrumentation Electrical and Electronics Measurements and Instrumentation Lab	5		
			iv) Core-10 (Th.4C + P.2C) Lab-13 (P 1 Cr.)	4 2	5 3	45 30	Digital Logic Design Digital Logic Design Lab	5		
			v) SEC-3 (Th.2C)	2	3	30	Introduction to MATLAB	5		
			vi) AECC-3 (P 2C)	2	3	30	Iintegrated Ccommunication Lab			
			vii) Audit Course	NC	-	-	Universal Social Responsibility-Community Outreach			
			viii) Audit Course	NC	-	-	Sports			
		SEMESTER -IV	i) Core-11 (Th.4C)	4	5	45	Engineering Science Electives**/ Mathematics-III	5		SET/SOBST
			ii) Core-12 (Th.4C + P.2C) Lab-14 (P.2C)	4 2	5 3	45 30	Electrical Machine Engineering I Electrical Machine Engineering I Lab	5		
			iii) Core-13 (Th.4C + P.2C) Lab-15 (P.2C)	4 2	5 3	45 30	Linear Integrated Circuit/ Linear Integrated Circuit	5		
			iv) VAC-3 (Th.4 C)	2	3	30	1. Indian Ethos & Modern Management 2. Ancient Sanskrit Language	5		SOAH
			v)Lab-16 (P.2C)	2	3	30	Analog Electronics Lab	5		
			vi)Lab-17 (P.2C)	2	0	30	Sports			
			vii)DSE-1 (Th.4C)	4	5	45	Sustainable Energy EMFT Smart Sensor Systems Electronic Devices & Circuits	5		
			viii)GE-1 (Th.4C)	4	5	45	Generic Elective-I (To be opt from other department)			
			ix)Audit Course				Industrial Visit/ Seminar/Presentation on the report of visits			

			x) Audit Course	NC	-	-	Universal Social Responsibility-Community Outreach				

Program Outcome:	**Program Specific Outcome:**
PO1 - PO12 [ANNEXTURE-1]	PSO1 - PSO4 [ANNEXTURE-2]

*** Internship/Industrial Training of 4 Weeks/5Weeks to be completed between the semester break**

*** Minor Certificate Paper-I**

Note: A total of 8 Credits are mandatory to earn from NPTEL/Moocs/Coursers etc during 4 years of B.Tech Program

Programme	Year	Semester (15 weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester)	Prerequisite	Elective (For other faculty)
BACHELOR OF TECHNOLOGY – ELECTRICAL AND ELECTRONICS ENGINEERING	THIRD YEAR	SEMESTER -V	i) Core - 14 (Th.4C + P.2C)	4 2	5 3	45 30	Control Systems Control Systems Lab	5		
			ii) Core - 15 (Th.4C + P.2C)	4 2	5 3	45 30	Electrical Machines Electrical Machines Lab-II	5		
			iii) Core - 16 (Th.4C + P.2C)	4 2	5 3	45 30	Elements of Power Systems Power Systems Lab	5		
			iv) DSE-2 (Th.4C)	4	5	45	Basics of AR/VR Sustainable Development Goals & Policies HVDC & AC Transmission Power System Stability	5		
			v) RP-1	NC			(Research Project)			
			vi) INT-1(P.2C)	2	3	30	Internship I			
			vii) Audit Course	NC	-	-	Universal Social Responsibility-Community Outreach			
			xvi) Audit Course	NC	-	-	Sports			
		SEMESTER - VI	i) Core - 17 (Th.4C + P.2C)	4 2	5 3	45 30	Power electronics Power electronics Lab			
			ii) Core - 18 (Th.4C + P.2C)	4 2	5 3	45 30	Microprocessor and Microcontroller Microprocessor Lab			

			iii) DSE-3(Th.4C)	4	5	45	1. SDEE-361 - Power System Analysis 2. SDEE-362 - Modern Control Systems 3. SDEE-363 - FACTS Controller 4. SDEE-364 - Electrical Machine Design	5		
			iv) SEC-5 (P.2C)	2	4	30	Short-Term Course in PLC			
			v) AECC-4(Th.4C)	4	5	45	Universal Human Values & Professional Ethics			SOAH
			vi) MP	2	3	50	Mini Project Lab			
			vii) RP-2	NC			(Research Project)			
			vii) Audit Course	NC	-	-	Universal Social Responsibility-Community Outreach			
			VIII)LAB 23(P 2 C)	NC	3	50	Sports			

Program Outcome:	**Program Specific Outcome:**
PO1 - PO12 [ANNEXTURE-1]	PSO1 - PSO4 [ANNEXTURE-2]

***Internship/Industrial Training of 4 Weeks/5Weeks to be completed between the semester break** ***Minor Certificate Paper-II & III**

Note: A total of 8 Credits are mandatory to earn from NPTEL/Moocs/Coursers etc during 4 years of B.Tech Program

Programme	Year	Semester (15 weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester)	Prerequisite	Elective (For other faculty)
BACHELOR OF TECHNOLOGY – ELECTRICAL AND ELECTRONICS ENGINEERING	FOURTH YEAR	SEMESTER - VII	i) Core-19 (Th.4C + P.2C)	4 2	5 3	45 30	Smart Grid	5		
			ii) GE-2 (Th.4C)	4	5	45	Generic Elective-2 (To be opted from other department)	5		
			iii) Lab-24	2	3	30	Industrial Electric Drives Lab	5		
			iv) PROJ(P.4 C)	4	8	45	Minor Project			
			v) INT-2(P. 2 C)	2	3	30	Internship			
			vii) Audit Course	NC	-	-	Universal Social Responsbility-Community Outreach			
			VIII)L AB 25	NC	3	50	Sports			

		SEMESTER - VIII	i) DSE-4(Th. 4C)	4	5	45	1. SDEE-481 - Fundamental of Electric Vehicles 2. SDEE-482 - Energy Conservation & Auditing 3. SDEE-483 - Digital Signal Processing 4. SDEE-484 - Biomedical Instrumentation	5		
			ii) GE-3 (Th.4C)	4	5	45	Generic Elective-3 (To be opted from other department)			
			iii) MAJP (P.10C)	10	20	60	Major Project			
*Major Project report will be evaluated by external & internal examiners & Research topic may be selected from the main core paper										

Note: A total of 8 Credits are mandatory to earn from NPTEL/Moocs/Coursers etc during 4 years of B.Tech Program

ANNEXURE-1

Program Outcomes:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and Research methods including design of experiments, analysis

and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

ANNEXTURE-2

Program Specific Outcomes:

PSO 1: Apply the fundamentals of mathematics, science and engineering knowledge to identify, formulate, design and investigate complex engineering problems of electric circuits, analog and digital electronics circuits, control systems, electrical machines and Power system.

PSO 2: Apply the appropriate techniques and modern engineering hardware and software tools in electrical engineering to engage in life-long learning and to successfully adapt in multi-disciplinary environments.

PSO 3: Aware of the impact of professional engineering solutions in societal, environmental context, professional ethics and be able to communicate effectively.

PSO 4: Produce rich aspirants of electrical engineers by imparting them electrical engineering concepts and the practical implementation in the form of projects.

Format-3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Mathematical Thinking with Calculus and Linear Algebra**
Course Code: ENAS-111	**Title: Mathematical Thinking with Calculus and Linear Algebra**

Course Objectives:

1. To gain the knowledge of differential calculus required for the field of engineering.
2. To deal with functions of several variables that is essential in optimizing the results of real life problems.
3. To understand Multiple integral tools to deal with engineering problems involving Surface area, volume etc.
4. To deal with vector calculus that is required in different branches of Engineering to graduate engineers.
5. To understand the essential tools of matrices and linear algebra, Eigen values and diagonalization in a Comprehensive manner are required.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Differential Calculus:** Rolle's Theorem, Mean Value Theorems, Successive Differentiation (nth order derivatives), Leibnitz theorem, Taylor's and Maclaurin's Theorems (without proof), Expansion of functions (standard forms),	9L
II	**Partial Differentiation:** Functions of several variables, Limit, Continuity, Partial derivatives, Euler's Theorem, Total derivative, Chain rule, Jacobians, Taylor's expansion for multivariable functions, Maxima and Minima of functions of two variables.	9L
III	**Integral Calculus:** Multiple integration: Double integral, Triple integral, Change of order of integration, Change of variables, Application: Areas and volumes.	9L
IV	**Vector Calculus:** Vector differentiation: Gradient, Curl and Divergence and their Physical interpretation, Directional derivatives. Vector Integration: Line integral, Surface integral, Volume integral, Gauss's Divergence theorem, Green's theorem and Stoke's theorem (without proof) and their applications	9L

V	**Linear Algebra:** Types of Matrices: Symmetric, Skew-symmetric and Orthogonal Matrices; Complex Matrices, Inverse and Rank of matrix using elementary transformations, System of linear equations, Characteristic equation, Eigen values and eigenvectors, Cayley-Hamilton Theorem and its application, Diagonalization of a Matrix.	**9L**

Text Books:

1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*

Reference Books:

1. *E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.*
2. *Veerarajan T., Engineering Mathematics for first year, McGraw-Hill, New Delhi, 2008.*
3. *R K. Jain & S R K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House 2002*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	Understand the concept of differentiability and apply in the study of Successive differentiation, Leibnitz theorems and Partial differentiation.	**L2 & L3**
CO-2	Identify the application of partial differentiation and apply for evaluating maxima, minima, series and Jacobians.	**L3 &L4**
CO-3	Illustrate the working methods of multiple integral and apply for finding area, volume.	**L1& L3**
CO-4	Remember the concept of vector and apply for directional derivatives, tangent and normal planes. Also evaluate line, surface and volume integrals.	**L2 & L3**
CO-5	Remember the concept of matrices and apply for solving linear simultaneous equations.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	2	2	1	2	1	0	0	0	0	1	0
CO-3	2	2	0	1	1	0	0	0	0	0	0	2
CO-4	3	0	2	1	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I / II**
Credits: 4 **Theory: 4** **Practical: 2**	**Subject: Modern Physics in Engineering**
Course Code: ENAS-112/ENAS-122	**Title: Modern Physics in Engineering**

Course Objectives:

1. To know the concept of Interference and Diffraction.
2. To know the significance of Maxwell's equations in the Engineering applications of electromagnetic waves.
3. Explain Quantum Mechanics to understand wave particle dualism. Necessity of quantum mechanics to explore.
4. To understand the concept of Relativistic Mechanics.
5. To understand the Phenomenon of Fiber optics and Laser.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)
50% Marks / 2 Credits

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Wave Optics:** Interference: Basics of interference of light, coherent Sources, Conditions of Interference; Interference by division of wave front and amplitude (Interference due to thin film, Wedge shaped film and Newton's Rings). **Diffraction:** Fraunh offer Diffraction Due Single slit, Diffraction Grating; Diffraction due to N slits, Rayleigh's criterion of resolution; absent spectra, dispersive Power of grating, Resolving power of Grating.	**12L**
II	**Electromagnetic:** Gauss law Ampere's law and displacement current; Equation of continuity; Maxwell's equations in Integral and Differential Forms; Electromagnetic Wave Propagation in Free Space and Conducting Media; Poynting Theorem	**9L**
III	**Quantum Mechanics:** Planck's concept (hypothesis), Compton Effect, Particle properties of wave: Matter Waves, Davisson Germer Experiment, Heisenberg Uncertainty Principle, Wave function, and Schrodinger equation (time dependent & independent), Particle in a 1-D box.	**9L**
IV	**Relativistic Mechanics:** Inertial and Non- Inertial Frames; Michelson-Morley Experiment; Postulates of Special Theory of Relativity; Galilean and Lorentz Transformation; Length Contraction and Time Dilation;	**9L**

	Addition of Velocities; Mass Energy Equivalence and Variation of Mass with Velocity.	
V	**Laser:** Absorption of radiation, Spontaneous and stimulated emission of radiation, Population inversion, Einstein's Coefficients, Principles of laser action, Components of laser, Solid state Laser (Ruby laser) and Gas Laser (He-Ne laser), Laser applications	**6L**

Text Books:
1. Concepts of Modern Physics – Aurthur Beiser (Mc-Graw Hill)
2. Introduction to Special Theory of Relativity- Robert Resnick (Wiley)
3. Engineering Physics: Theory and Practical- Katiyar and Pandey (Wiley India)

Reference Books:
1. *Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New)*
2. *Engineering Physics-Malik HK and Singh AK (McGrawHill)*

If the course is available as **Generic Elective**, then the students of following departments may opt it: NO

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Physics of Class 12

Course Learning Outcomes:

CO-1	Apply the principles of wave optics to analyze and predict light behavior in various scenarios.	**L3 & L4**
CO-2	Analyze and solve problems involving electromagnetic fields and waves in various contexts.	**L4**
CO-3	Remember and apply the principles of quantum mechanics to understand and predict the behavior of particles at the atomic and subatomic levels.	**L1 & L3**
CO-4	Understand the principles of relativistic mechanics to analyze and predict the behavior of objects moving at velocities close to the speed of light.	**L2 & L4**
CO-5	Understand and apply the principles of laser technology.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B. Tech. ME**	**Year: I** **Semester: I/II**
Credits: 4 **Theory: 4** **Practical: 0**	**SUBJECT: ENGINEERING CHEMISTRY**
Course Code: ENAS-113/ ENAS-123	**Title: ENGINEERING CHEMISTRY**

Course Objectives:

1. To enable the students to understand about the Chemistry of Atomic and Molecular structure, Chemistry of advanced Materials like Liquid crystals, Nanomaterials, Graphite & fullerenes, and Green Chemistry.
2. To enable the students to understand and apply the detailed concepts of spectroscopic techniques and stereochemistry to identify the compounds, element etc.
3. To enable the students to understand and apply the concepts related to Electrochemistry, Batteries, Corrosion and Chemistry of Engineering Materials like cement.
4. To enable the students to understand and apply detailed concepts of water source, water impurities, hardness of water and boiler troubles used in industry as well as analysis of coal & determination of calorific values.
5. To enable the students to understand detailed concepts related to polymers, Polymerization, Polymer Blends, Polymer Composites, and organometallic compounds.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Atomic and Molecular Structure:** Molecular orbitals of diatomic molecules (bond order, magnetic characters and numerical problems). **Chemistry of Advanced Materials:** ***Liquid Crystals;*** Introduction, Types and Applications of liquid crystals, industrially important materials used as liquid crystals. ***Graphite and Fullerene;*** Introduction, Structure and applications. ***Nanomaterials;*** Introduction, Preparation, characteristics of nanomaterials and applications of nanomaterials: Carbon Nano Tubes (CNT) and graphene. **Green Chemistry:** Introduction to green chemistry, 12 principles and importance of green Synthesis, Green Chemicals, Synthesis of typical organic compounds by conventional and Green routes (Adipic acid and Paracetamol), Environmental impact of Green chemistry on society.	**10L**
II	**Spectroscopic techniques and Applications:** Elementary idea and simple applications of Ultraviolet (UV) & Visible, fluorescence,	**8L**

	Jablonski diagram, IR and Raman spectroscopy. **Stereochemistry:** Optical isomerism in compounds without chiral carbon, Geometrical isomerism, Chiral Drugs.	
III	**Electrochemistry:** Nernst Equation and application, relation of EMF with thermodynamic functions (ΔH, ΔF and Δ S). Lead storage battery. **Corrosion**; causes, effects and its prevention. **Chemistry of Engineering Materials:** ***Cement;*** Constituents, manufacturing, hardening and setting, deterioration of cement, Plaster of Paris (POP).	**9L**
IV	**Water Analysis:** Hardness of water, Techniques for water softening (Lime-soda, Zeolite, Ion exchange resin and Reverse osmosis method). **Fuels:** classification of fuels, Analysis of coal, Determination of calorific value (Bomb calorimeter and Dulon's method).	**8L**
V	**Polymers:** Basic concepts of Polymer-Blend and composites, Conducting and biodegradable polymers. Preparation and application of some industrially important polymers (Buna-S, Buna-N, Neoprene, Nylon-6, nylon-6,6, Teflon, Lucite, Bakelite, and Terylene). **Organometallic Compounds:** General methods of synthesis of organometallic compounds (Grignard reagent and lithium aluminum hydride) and their applications.	**9L**

Reference Books:

1. Engineering Chemistry by Rath & Singh, 2nd Edition, Cengage Learning India Pvt. Ltd Delhi.
2. Engineering Chemistry by SS Dara, S Chand & Co Ltd
3. Engineering Chemistry by Jain & Jain, S. Chand & Comp, New Delhi
4. Engineering Chemistry by K. Sesha Maheswaramma, Pearson
5. Engineering Chemistry by OG Palanna, Mc Graw Hill Education, New Delhi
6. Engineering Chemistry by Shashi Chawala, Dhanpat Rai Publishing Comp, New Delhi

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NA**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: NA

Course Learning Outcomes: After completion of the course, the student should be able to:

CO-1	Understand about the principles of atomic and molecular structure, bonding and properties, chemistry of advanced materials like Liquid Crystals, Nanomaterials, Graphite, graphene & Fullerenes as well as the principles of green chemistry.	**L1 & L2**
CO-2	Apply the fundamental concepts of determination of structure with various	**L2 & L3**

	spectral techniques and stereochemistry	
CO-3	Apply the theory of construction of electrodes, batteries and fuel cells and re-designing or new engineering products, and categorize the reasons for corrosion and study methods to control corrosion, and develop an understanding of the chemistry of cement.	**L3 & L2**
CO-4	Understand the sources, impurities and hardness of water, apply the concepts of determination of calorific values and analyze the coal.	**L2, L3 & L4**
CO-5	Understand the chemical structure of polymers and its effect on their various properties when used as engineering materials. Understanding the applications of specific polymers and organometallic compounds, applicable in industrial process.	**L1 & L2**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	3	2	2	2	2	0	0	0	0	2
CO-2	2	3	2	3	3	1	1	0	0	0	0	2
CO-3	3	3	3	3	2	2	2	0	1	0	0	1
CO-4	3	3	3	2	2	2	2	0	0	0	0	1
CO-5	3	3	2	2	2	2	2	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**SUBJECT: FUNDAMENTALS OF MECHANICAL AND MECHATRONICS SYSTEMS**
Course Code: ENME-111N	**TITLE: FUNDAMENTALS OF MECHANICAL AND MECHATRONICS SYSTEMS**

Course Objectives:

1. Introduce fundamental principles and theories in Mechanical Engineering.
2. Provide an overview of the historical development and current trends in Mechanical Engineering.
3. Familiarize students with basic engineering concepts such as forces, materials, structures, and systems relevant to both disciplines.
4. Develop problem-solving skills through practical applications and case studies in Mechanical Engineering contexts.
5. Cultivate an understanding of the interdisciplinary nature of Engineering and its impact on society and the environment.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Materials:** Classification of engineering material, Composition of Cast iron and Carbon steels, Iron Carbon diagram. Mechanical properties like strength, hardness, toughness, ductility, brittleness, malleability etc. of materials. Hooks law and modulus of elasticity, Hardness and Impact testing of materials, BHN etc.	9L
II	**Force Systems**: Basic concepts: Definitions, Basic assumptions, Scalar & Vector quantities, Classification of forces & Representation, Force as a Vector, Composition of forces, Parallelogram Law, Resolution, Principle of Transmissibility of forces **Coplanar Concurrent Force system and Coplanar:** Equilibrium of coplanar force system, Free body diagrams, Determination of reactions, Equilibrium of a body under three forces, Lami's theorem.	9L
III	**Introduction to mechanics of solid:**	9L

	Normal and shear Stress, strain, Hookes' law, Poisson's ratio, elastic constants and their relationship, stress-strain diagram for ductile and brittle materials, factor of safety. Basic Numerical problems. Types of beams under various loads.	
IV	**Thermodynamics:** Thermodynamic system, properties, state, process, Zeroth, First and second law of thermodynamics, thermodynamic processes at constant pressure, volume, enthalpy & entropy. Steam Engineering: Classification and working of boilers, mountings and accessories of boilers, Efficiency.	**9L**
V	**Fundamental of Mechatronics:** Definition of Mechatronics, Sensors and Transducers: Definition, difference, classification, Actuators: Definition and Classification of Actuators Need and Scope, Programmable Logic Controller (PLC): Definition, PLC block diagram, Microcontroller: Comparison of Microprocessor and Microcontroller	**9L**

Text Books:
1. Nag P.K, Engineering Thermodynamics, TMH.
2. Agrawal C M, Basic Mechanical Engineering, Wiley Publication.

Reference Books:
1. Nag P.K, Engineering Thermodynamics, TMH.
2. Achuthan M, Engineering Thermodynamics, PHI. List of Suggestive
3. Ganesan, Internal Combustion Engines, TMH.
4. Textbook Of Mechatronics. R K Rajput

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand mechanical properties such as strength, hardness, toughness, ductility, brittleness, and malleability.	**L2 & L3**
CO-2	Understand the working principles of Lamis theorem	**L3 &L4**
CO-3	Understand steam engineering principles including boiler classification, mountings, accessories, and efficiency.	**L1& L3**
CO-4	Understand the concepts and purposes of various forces.	**L2 & L3**
CO-5	Understand about the basics of Mechatronics.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)												
CO-PO Mapping												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Structured Programming and Problem Solving in C**
Course Code: ENCS-111	**Title: Structured Programming and Problem Solving in C**

Course Objectives:

1. To understand the basics of computers, programming languages, the history and structure of the C language, and its compilation and execution process.
2. To learn to define problems, analyze them, and create solutions using algorithms, flowcharts, and pseudo code.
3. To gain proficiency in data types, variables, constants, literals, operators, expressions, and input/output functions in C.
4. To apply conditional statements, switch-case statements, looping structures, and functions, including recursion and library functions, in C programs.
5. To Work with arrays, strings, pointers, structures, unions, file handling, preprocessor directives, and advanced data structures, and solve real-world problems through case studies and project-based learning.

Nature of Paper: VAC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION TO PROGRAMMING AND PROBLEM SOLVING:** **INTRODUCTION TO COMPUTERS AND PROGRAMMING:** Overview of computers and programming languages, History and evolution of C language, Basic structure of a C program, Compilation and execution process. **PROBLEM SOLVING TECHNIQUES:** Problem definition and analysis, Algorithms and flowcharts, Pseudocode **FUNDAMENTALS OF C:** Data types and variables, Constants and literals, Operators and expressions, Input and output functions.	**9L**
II	**CONTROL STRUCTURES AND FUNCTIONS:** **CONTROL STRUCTURES:** Conditional statements (if, if-else, nested if), Switch-case statements, looping structures (for, while, do-while), Break and continue statements, **FUNCTIONS:** Function declaration and definition, Function calling and	**9L**

	parameter passing, Scope and lifetime of variables, Recursive functions, Library functions.	
III	**ARRAYS, STRINGS, AND POINTERS:** **ARRAYS:** One-dimensional arrays, Two-dimensional arrays, Multidimensional arrays, Array operations and applications, **STRINGS:** String handling functions, String manipulation techniques. **POINTERS:** Introduction to pointers, Pointer arithmetic, Pointers and arrays, Pointers to functions, Dynamic memory allocation.	**9L**
IV	**STRUCTURES, UNIONS, AND FILE HANDLING:** **STRUCTURES AND UNIONS:** Defining and declaring structures, Accessing structure members, Array of structures, Nested structures, Unions and their applications. **FILE HANDLING:** File operations (opening, closing, reading and writing), File modes, Sequential and random access files, Error handling in file operations.	**9L**
V	**ADVANCED TOPICS AND CASE STUDIES:** **PREPROCESSOR DIRECTIVES:** Macros, File inclusion, Conditional compilation. **ADVANCED DATA STRUCTURES:** Introduction to linked lists, Stacks and queues (concepts and basic operations). **PROBLEM SOLVING CASE STUDIES:** Real-world problem solving using C, Case studies and project-based learning, Debugging and testing techniques, Best practices in programming.	**9L**

Text Books:

1. *Computer Programming with C, Special Edition-MRCET, Mc Graw Hill Publishers 2017,*
2. *Computer Science: A Structured Programming Approach Using C, B, A, Forouzan and R, F, Gilberg, Third Edition, Cengage Learning,*

Reference Books:

1. *The C Programming Language, B, W, Kernighan and Dennis M, Ritchie, PHI*
2. *Computer Programming, E, Balagurusamy, First Edition, TMH*
3. *C and Data structures – P, Padmanabham, Third Edition, B, S, Publications,*

If the course is available as **Generic Elective**, then the students of following departments may opt it: NO

Evaluation/Assessment Methodology

Category	Max, Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Students will demonstrate an understanding of the fundamentals of computers, and evolution of the C programming language, the basic structure of a C program, and the compilation and execution processes.	**L2 & L3**
CO-2	Students will be able to define and analyze programming problems, develop algorithms, create flowcharts, and write pseudo code to design effective solutions.	**L1,L2& L3**
CO-3	Students will gain proficiency in fundamentals of C and will be able to implement basic input and output functions.	**L1,L2& L3**
CO-4	Students will be able to apply conditional statements, switch-case statements, and looping structures to control program flow, and will understand function declaration, definition, calling, parameter passing, scope, lifetime of variables, and recursion.	**L2,L3 & L4**
CO-5	Students will demonstrate the ability to work with arrays, strings, and pointers, define and utilize structures and unions, perform file operations, and understand advanced data structures like linked lists, stacks, and queues. They will also be able to solve real-world problems using C.	**L2,L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	3	1	2	2	1	0	0	0	1	2	3
CO-2	3	2	3	2	1	1	0	0	0	1	1	1
CO-3	3	2	2	2	1	0	0	0	0	0	1	3
CO-4	2	3	3	2	2	1	0	0	0	1	2	2
CO-5	1	3	2	3	2	1	0	0	0	0	1	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I/II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Professional Communication and Digital fluency**
Course Code: ENAS-114/ ENAS-124	**Title: Professional Communication and Digital fluency**

Course Objectives:

1. To understand and apply basic principles of professional communication, including the communication process and overcoming barriers.
2. To enhance the essentials of technical writing for engineering, including reports, documentation, professional emails, and proposals.
3. To gain confidence in public speaking, create effective presentations, and learn to engage different audiences.
4. To develop skills for building rapport, effective teamwork, conflict resolution, and leadership communication.
5. To learn to effectively use digital communication tools, social media, and adapt to emerging trends in global engineering contexts.

Nature of Paper: AECC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Fundamentals of Communication:** Definition and importance, Communication process, Verbal and non-verbal communication, Barriers to communication, Formal and informal communication.	9L
II	**Professional Speaking and Presentation Skills:** Public speaking, Group discussion, Effective oral communication, Use of visual aids, Body language, Elevator pitch, Presentation planning and delivery.	9L
III	**Business and Technical Writing:** Email etiquette, Resume and cover letter writing, Report writing, Technical documentation, Memos, Minutes of meetings.	9L
IV	**Digital Literacy and Collaboration Tools:** Digital platforms for communication (Zoom,Teams, Slack), Cloud collaboration (Google Docs, OneDrive), Etiquette of digital communication, Netiquette, Cyber safety.	9L
V	**Professionalism and Work Ethics:** Workplace behavior, Teamwork, Leadership communication, Conflict resolution, Time management, Building	9L

	online presence through LinkedIn and digital portfolios.	

Text Books and Reference Books:

1. *"Technical Communication: A Practical Approach" by William Sanborn Pfeiffer and Kaye E. Adkins*
2. *"The Essentials of Technical Communication" by Elizabeth Tebeaux and Sam Dragga*
3. *"Engineering Communication" by Charles W. Knisely and Karin I. Knisely*
4. *"Communicating in Groups: Applications and Skills" by Katherine Adams, Gloria Galanes, and Brandi R. Fritz*
5. *"Digital Communications: Fundamentals and Applications" by Bernard Sklar*

If the course is available as **Generic Elective**, then the students of following departments may opt it: NO

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations/Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: English of Class 12

Course Learning Outcomes:

CO-1	Demonstrate effective communication skills, including verbal, non-verbal, and written, in professional engineering contexts.	**L2 & L3**
CO-2	Develop clear, concise, and coherent technical documents, including reports, project documentation, and professional emails.	**L3 &L4**
CO-3	Deliver engaging and informative oral presentations tailored to diverse audiences, utilizing effective visual aids and presentation techniques.	**L1& L3**
CO-4	Exhibit strong interpersonal and teamwork skills, including active listening, conflict resolution, and leadership communication.	**L2 & L3**
CO-5	Utilize digital communication tools and social media platforms to enhance professional networking and collaboration, adapting to emerging communication trends and global engineering contexts.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I/II**
Credits: 5 **Theory: 4** **Practical: 1**	**SUBJECT: ENVIRONMENT, ECOLOGY AND SUSTAINIBILITY**
Course Code: ENHU-112/ ENHU-122P	**TITLE: ENVIRONMENT, ECOLOGY AND SUSTAINIBILITY**

Course Objectives:

1. To introduce students to the interrelationship between humans and the environment, tracing historical, cultural, and ethical dimensions of sustainability.
2. To equip students with knowledge about natural resources, biodiversity, ecosystems, and their conservation strategies.
3. To raise awareness of major environmental issues local to global—such as pollution, climate change, land degradation, and disaster risk.
4. To familiarize students with environmental laws, policies, and international treaties related to environmental governance and sustainable development.
5. To encourage experiential learning through field visits, case studies, and hands-on campus environmental management activities.

Nature of Paper: AECC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)
50% Marks / 1 Credits

L : 3	T : 1	P : 3	C : 4+1

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Humans and the Environment:** The man-environment interaction: Humans as hunter-gatherers; Mastery of fire; Origin of agriculture; Emergence of city-states; Great ancient civilizations and the environment, Indic Knowledge and Culture of sustainability; Middle Ages and Renaissance; Industrial revolution and its impact on the environment; Population growth and natural resource exploitation; Global environmental change. **Environmental Ethics and emergence of environmental ism**: Anthropocentric and eco-centric perspectives (Major thinkers); The Club of Rome- Limits to Growth; UN Conference on Human Environment 1972; World Commission on Environment and Development and the concept of sustainable development; Rio Summit and subsequent international efforts.	9L
II	**Natural Resources and Sustainable Development**: Overview of natural resources: Definition of resource; Classification of natural resources- biotic and abiotic, renewable and non-renewable.	9L

	Biotic resources: Major type of biotic resources- forests, grasslands, wetlands, wildlife and aquatic (fresh water and marine); Microbes as a resource; Status and challenges. **Water resources**: Types of water resources- fresh water and marine resources; Availability and use of water resources; Environmental impact of over-exploitation, issues and challenges; Water scarcity and stress; Conflicts over water. **Soil and mineral resources**: Important minerals; Mineral exploitation; Environmental problems due to extraction of minerals and use; Soil as a resource and its degradation. **Energy resources**: Sources of energy and their classification, renewable and non-renewable sources of energy; Conventional energy sources- coal, oil, natural gas, nuclear energy; Non-conventional energy sources- solar, wind, tidal, hydro, wave, ocean thermal, geothermal, biomass, hydrogen and fuel cells; Implications of energy use on the environment. **Introduction to sustainable development**: Sustainable Development Goals (SDGs) - targets and indicators, challenges and strategies for SDGs.	
III	**Environmental Issues: Local, Regional and Global:** **Environmental issues and scales**: Concepts of micro-, meso-, synoptic and planetary scales; Temporal and spatial extents of local, regional, and global phenomena. **Pollution**: Impact of sectoral processes on Environment; Types of Pollution- air, noise, water, soil, thermal, radioactive; municipal solid waste, hazardous waste; transboundary air pollution; acid rain; smog. Land use and Land cover change: land degradation, deforestation, desertification, urbanization. Biodiversity loss: past and current trends, impact. **Global change**: Ozone layer depletion; Climate change. Disasters – Natural and Man-made	**9L**
IV	**Conservation of Biodiversity and Ecosystems:** Biodiversity and its distribution: Biodiversity as a natural resource; Levels and types of biodiversity; Biodiversity in India and the world; Biodiversity hotspots; Species and ecosystem threat categories. **Ecosystems and ecosystem services**: Major ecosystem types in India and their basic characteristics- forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services- classification and their significance. Threats to biodiversity and ecosystems: Land use and land cover change; Commercial exploitation of species; Invasive species; Fire, disasters and climate change. **Major conservation policies**: in-situ and ex-situ conservation approaches; Major protected areas; National and International Instruments for biodiversity conservation; the role of traditional knowledge, community-based conservation; Gender and conservation.	**9L**
V	Environmental Pollution and Health: Understanding pollution: Production processes and generation of wastes; Assimilative capacity of the environment; Definition of pollution; Point sources and non-point sources of pollution. Air pollution: Sources of air pollution; Primary and secondary pollutants; Criteria pollutants- carbon monoxide, lead, nitrogen oxides, ground-level	**9L**

	ozone, particulate matter and sulphur dioxide; Other important air pollutants- Volatile Organic compounds (VOCs), Peroxyacetyl Nitrate (PAN), Polycyclic aromatic hydrocarbons (PAHs) and Persistent organic pollutants (POPs); Indoor air pollution; Adverse health impacts of air pollutants; National Ambient Air Quality Standards. Water pollution: Sources of water pollution; River, lake and marine pollution, groundwater pollution; water quality Water quality parameters and standards; adverse health impacts of water pollution on human and aquatic life. Soil pollution and solid waste: Soil pollutants and their sources; Solid and hazardous waste; Impact on human health. Noise pollution: Definition of noise; Unit of measurement of noise pollution; Sources of noise pollution; Noise standards; adverse impacts of noise on human health. Thermal and Radioactive pollution: Sources and impact on human health and ecosystems.	
VI	Climate Change: Impacts, Adaptation and Mitigation: Understanding climate change: Natural variations in climate; Structure of atmosphere; Anthropogenic climate change from greenhouse gas emissions– past, present and future; Projections of global climate change with special reference to temperature, rainfall, climate variability and extreme events; Importance of 1.5 °C and 2.0 °C limits to global warming; Climate change projections for the Indian sub-continent. Impacts, vulnerability and adaptation to climate change: Observed impacts of climate change on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests and natural ecosystems; Impacts on animal species, agriculture, health, urban infrastructure; the concept of vulnerability and its assessment; Adaptation vs. resilience; Climate-resilient development; Indigenous knowledge for adaptation to climate change. **Mitigation of climate change**: Synergies between adaptation and mitigation measures; Green House Gas (GHG) reduction vs. sink enhancement; Concept of carbon intensity, energy intensity and carbon neutrality; National and international policy instruments for mitigation, decarbonizing pathways and net zero targets for the future; Energy efficiency measures; Renewable energy sources; Carbon capture and storage, National climate action plan and Intended Nationally Determined Contributions (INDCs); Climate justice.	**9L**
VII	Environmental Management: Introduction to environmental laws and regulation: Constitutional provisions- Article 48A, Article 51A (g) and other derived environmental rights; Introduction to environmental legislations on the forest, wildlife and pollution control. Environmental management system: ISO 14001 Concept of Circular Economy, Life cycle analysis; Cost-benefit analysis Environmental audit and impact assessment; Environmental risk assessment Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability; Ecolabeling/Ecomark scheme	**9L**
VIII	**Environmental Treaties and Legislation**: An overview of instruments of international cooperation; bilateral and multilateral agreements;	**9L**

	conventions and protocols; adoption, signature, ratification and entry into force; binding and non- binding measures; Conference of the Parties (COP) **Major International Environmental Agreements**: Convention on Biological Diversity (CBD); Cartagena Protocol on Biosafety; Nagoya Protocol on Access and Benefit-sharing; **Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES);** Ramsar Convention on Wetlands of International Importance; United Nations Convention to Combat Desertification (UNCCD); Vienna Convention for the Protection of the Ozone Layer; Montreal Protocol on Substances that Deplete the Ozone Layer and the Kigali Amendment; Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal; Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade; Stockholm Convention on Persistent Organic Pollutants; Minamata Convention on Mercury; United Nations Framework Convention on Climate Change (UNFCCC); Kyoto Protocol; Paris Agreement; India's status as a party to major conventions **Major Indian Environmental Legislations**: The Wild Life (Protection) Act, 1972; The Water (Prevention and Control of Pollution) Act, 1974; The Forest (Conservation) Act, 1980; The Air (Prevention and Control of Pollution) Act, 1981; The Environment (Protection) Act, 1986; The Biological Diversity Act, 2002; The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006; Noise Pollution (Regulation and Control) Rules, 2000; Industry-specific environmental standards; Waste management rules; Ramsar sites; Biosphere reserves; Protected Areas; Ecologically Sensitive Areas; Coastal Regulation Zone; Status phase-out of production and consumption of Ozone Depleting Substances by India; National Green Tribunal; Some landmark Supreme Court judgements **Major International organizations and initiatives**: United Nations Environment Programme (UNEP), International Union for Conservation of Nature (IUCN), World Commission on Environment and Development (WCED), United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Panel on Climate Change (IPCC), and Man and the Biosphere (MAB) programme.	
IX	**Case Studies and Field Work**: The students are expected to be engaged in some of the following or similar identified activities: 1. Discussion on one national and one international case study related to the environment and sustainable development. 2. Field visits to identify local/regional environmental issues, make observations including data collection and prepa re a brief report. 3. Participation in plantation drive and nature camps. 4. Documentation of campus biodiversity. Campus environmental management activities such as solid waste disposal, water Management and sanitation, and sewage treatment.	**9L**

Reference Books: Reference Books:

1. Fisher, Michael H. (2018) An Environmental History of India- From Earliest Times to the Twenty-

First Century, Cambridge University Press.
2. Hedrick, Daniel R. (2020) Humans versus Nature- A Global Environmental History, Oxford University Press.
3. Hughes, J. Donald (2009) An Environmental History of the World- Humankind's Changing Role in the Community of Life, 2nd Edition. Routledge.
4. Perman, R., Ma, Y., McGillivray, J., and Common, M. (2003) Natural Resource and Environmental Economics. Pearson Education.
5. Simmons, I. G. (2008). Global Environmental History: 10,000 BC to AD 2000. Edinburgh University Press
6. Chiras, D. D and Reganold, J. P. (2010). Natural Resource Conservation: Management for a Sustainable Future.10th edition, Upper Saddle River, N. J. Benjamin/Cummins/Pearson.
7. John W. Twidell and Anthony D. (2015). Renewable Energy Sources, 3rd Edition, Weir Publisher (ELBS)
8. William P.Cunningham and Mary A. (2015) Cunningham Environmental Science: A Global Concern, Publisher (Mc-Graw Hill, USA)
9. Gilbert M. Masters and W. P. (2008). An Introduction to Environmental Engineering and Science, Ela Publisher (Pearson)
10. Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications https://sdgs.un.org/goals
11. Harper, Charles L. (2017) Environment and Society, Human Perspectives on Environmental Issues 6th Edition. Routledge.
12. Harris, Frances (2012) Global Environmental Issues, 2nd Edition. Wiley- Blackwell.
13. William P. Cunningham and Mary A. (2015). Cunningham Environmental Science: A global concern, Publisher (Mc-Graw Hill, USA)
14. Manahan, S.E. (2022). Environmental Chemistry (11th ed.). CRC Press. https://doi. org/10.1201/9781003096238
15. Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press.
16. Bawa, K.S., Oomen, M.A. and Primack, R. (2011) Conservation Biology: A Primer for South Asia. Universities Press.
17. Sinha, N. (2020) Wild and Wilful. Harper Collins, India.
18. Varghese, Anita, Oommen, Meera Anna, Paul, Mridula Mary, Nath, Snehlata (Editors) (2022) Conservation through Sustainable Use: Lessons from India. Routledge.
19. Bhagwat, Shonil (Editor) (2018) Conservation and Development in India: Reimagining Wilderness, Earthscan Conservation and Development, Routledge.
20. Krishnamurthy, K.V. (2003) Textbook of Biodiversity, Science Publishers, Plymouth, UK
21. Jackson, A. R., & Jackson, J. M. (2000). Environmental Science: The Natural Environment and Human Impact. Pearson Education.
22. Masters, G. M., & Ela, W. P. (2008). *Introduction to environmental engineering and science* (No. 60457). Englewood Cliffs, NJ: Prentice Hall.
23. Miller, G. T., & Spoolman, S. (2015) Environmental Science. Cengage Learning.
24. Central Pollution Control Board Web page for various pollution standards. https://cpcb.nic.in/ standards/
25. Ahluwalia, V. K. (2015). *Environmental Pollution, and Health*. The Energy and Resources Institute (TERI).
26. Pittock, Barrie (2009) Climate Change: The Science, Impacts and Solutions. 2nd Edition. Routledge.
27. www.ipcc.org; https://www.ipcc.ch/report/sixth-assessment-report-cycle/.

28. Adenle A., Azadi H., Arbiol J. (2015). Global assessment of technological innovation for climate change adaptation and mitigation in developing world, Journal of Environmental Management, 161 (15): 261-275.
29. Barnett, J. & S. O'Neill (2010). Maladaptation. Global Environmental Change—Human and Policy Dimensions 20: 211–213.
30. Berrang-Ford, L., J.D. Ford & J. Paterson (2011). Are we adapting to climate change? Global Environmental Change—Human and Policy Dimensions 21: 25-33.
31. Jørgensen, Sven Marques, Erik João Carlos and Nielsen, Søren Nors (2016) Integrated Environmental Management, A trans disciplinary Approach. CRC Press.
32. Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.
33. Barrow, C. J. (1999). Environmental management: Principles and practice. Routledge.
34. Tiefenbacher, J (ed.) (2022), Environmental Management - Pollution, Habitat, Ecology, and Sustainability, Intech Open, London. 10.5772/
35. Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.
36. UNEP (2007) Multilateral Environmental Agreement Negotiator's Handbook, University of Joensuu, ISBN 978-952-458-992-5
37. Ministry of Environment, Forest and Climate Change (2019) A Handbook on International Environment Conventions & Programmes. https://moef.gov.in/wp- content/uploads/2020/02/ convention-V-16-CURVE-web.pdf
38. Kanchi Kohli and Manju Menon (2021) Development of Environment Laws in India, Cambridge University Press.
39. India Code – Digital repository of all Central and State Acts: https://www.indiacode.nic.in/Bohra, Saroj, Judicial Intervention and Evolution of Environmental Principles and Doctrines (January 7, 2019). Available at SSRN: https://ssrn.com/abstract=3311406 or http://dx.doi. org/10.2139/ssrn.3311406

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Course Learning Outcomes:

CO1	Explain the evolution of human-environment interaction, environmental ethics, and sustainability principles.	L2
CO2	Classify natural resources and evaluate their usage, challenges, and conservation strategies.	L3
CO3	Analyze local, regional, and global environmental issues, including pollution, biodiversity loss, and land use change.	L4

CO4	Interpret the causes, consequences, and mitigation strategies of climate change and global environmental change.	L3
CO5	Describe key environmental policies, laws, and treaties at national and international levels.	L2

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO1	2	1	1	1	1	2	3	2	1	2	0	2
CO2	2	2	2	2	1	2	3	2	0	1	0	3
CO3	1	2	2	2	1	3	3	2	1	2	0	3
CO4	2	2	2	2	2	3	3	2	1	2	0	3
CO5	2	1	1	1	1	3	3	3	0	2	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I/II**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: MODERN PHYSICS IN ENGINEERING LAB**
Course Code: ENAS-112P/ ENAS-122P	**Title: MODERN PHYSICS IN ENGINEERING LAB**

Course Objectives:
1. To understand the concept of wave length by the interference
2. To understand the concept of wave length by the diffraction.
3. To understand the concept of viscosity of liquid and flow of liquid
4. To understand the energy band gap in the semiconductors
5. To understand the concept of polarization

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	To determine the wavelength of Sodium light by Newton's rings
Practical-2.	To determine the wavelength of prominent lines of mercury by plane diffraction grating
Practical-3.	To determine the focus length combination of two lenses separated by distance and verify the formula for the focal length of combination of lenses
Practical-4.	To determine the wave length of sodium light with the help of Fresnel's bi-prism
Practical-5.	To determine the coefficient of viscosity of a given liquid
Practical-6.	To verify Stefan's law
Practical-7.	Calibration of a volt meter with potentiometer
Practical-8.	To determine the resistance per unit length and specific resistance of a given resistance using Carey Foster 's Bridge
Practical-9.	To determine the energy bend gap of a given semiconductor material
Practical-10.	To determine the Specific Rotation of the Cane sugar solution with the help of Polarimeter

Reference/Text Books:
1. *Practical Physics- K. K. Dey & B. N. Dutta (Kalyani Publishers New Delhi)*
2. *Engineering Physics- Practical- Katiyar & Pandey (Wiley India)*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce (External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	To determine the wavelength of sodium light by Newton's ring experiment	**L3**
CO-2	To determine the wavelength of sodium light with the help of Fresnel's bi-prism	**L3**
CO-3	To determine the viscosity of liquid.	**L3**
CO-4	To determine the emission of energy with respect the temperature and verify Stefan's law.	**L3 & L4**
CO-5	To determine the calibration of potential and draw the curve.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	2	0	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	2	2	1	0	0	0	0	0	0	2	2
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I & II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: Engineering Chemistry Lab**
Course Code: ENAS-113P/ ENAS-123P	**Title: Engineering Chemistry Lab**

Course Objectives:
1. Student will be able to Estimate different impurities present in water sample.
2. Student will be able to Determine molecular properties such as surface tension, viscosity, pH, conductance and concentration of solution.
3. Student will be able to Identify iron concentration and percentage of available chlorine in supplied sample using titration methods

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	To determine total alkalinity in the given water sample.
Practical-2.	To determine the temporary and permanent hardness in water sample using EDTA as standard solution.
Practical-3.	To determine the available chlorine in bleaching powder solution.
Practical-4.	To determine the chloride content in the given water sample by Mohr's method.
Practical-5.	To determine the pH of the given solution using pH meter and pH-metric titration.
Practical-6.	To determine the Equivalent weight of Iron by the chemical displacement method.
Practical-7.	To determine the Viscosity of an addition polymer like polyester by Viscometer.
Practical-8.	To find chemical oxygen demand of waste water sample by potassium dichromate
Practical-9.	To determine the iron content in the given sample using external indicator
Practical-10.	To determine the strength of given HCL solution by titrating against N/10 Standard Sodium hydroxide solution

Reference/Text Books:
1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks

1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce (External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Estimate different impurities present in water sample.	**L4**
CO-2	Determine molecular properties such as surface tension, viscosity, pH, conductance and concentration of solution	**L3**
CO-3	Identify iron concentration and percentage of available chlorine in supplied sample using titration methods.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	0	2	1	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	3	3	1	0	0	0	0	0	0	2	1
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I & II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: PROGRAMMING WITH C LAB: HANDS ON LOGIC BUILDING**
Course Code: ENCS-111P	**Title: PROGRAMMING WITH C LAB: HANDS ON LOGIC BUILDING**

Course Objectives:

1. To develop proficiency in implementing fundamental programming constructs such as loops, conditionals, functions, and arrays in C language through hands-on lab exercises.
2. To Gain practical experience in implementing and using data structures like arrays, linked lists, stacks, and queues to solve programming problems during lab sessions.
3. To Enhance problem-solving skills by applying algorithms learned in theory to practical programming tasks.
4. To engage in project-based learning activities where students work in teams to tackle larger programming projects.
5. To acquire skills in debugging and error handling techniques by identifying and resolving common programming errors encountered during lab exercises, ensuring robust and error-free code.

Nature of Paper: VAC (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Develop a program that performs basic arithmetic operations (addition, subtraction, multiplication, division) based on user input.
Practical-2.	Create a program to convert temperatures between Celsius, Fahrenheit, and Kelvin.
Practical-3.	Build a basic ATM simulation that allows users to check balance, deposit, and withdraw money.
Practical-4.	Develop a program to simulate a simple voting system with options and tallying votes.
Practical-5.	Create a program to calculate student grades based on user input of marks.
Practical-6.	Write a program that identifies whether a number is odd or even.
Practical-7.	Develop a program to check if a given year is a leap year.
Practical-8.	Create a program to solve quadratic equations.
Practical-9.	Implement a menu-driven program that performs different tasks like calculating area, volume, etc., based on user choice.

Practical-10.	Develop a recursive function to compute the factorial of a number.
Practical-11.	Develop a program to store and manipulate student marks using arrays. Calculate average, highest, and lowest marks.
Practical-12.	Implement a program to perform multiplication of two matrices.
Practical-13.	Create a function to reverse a string without using library functions.
Practical-14.	Write a program to dynamically allocate memory for an array and perform operations on it (e.g., finding the maximum element).
Practical-15.	Implement linear and binary search algorithms to find an element in an array
Practical-16.	Develop a program to check if a given string is a palindrome.
Practical-17.	Create a function that swaps two variables using pointers.
Practical-18.	Write a program to count the frequency of each character in a string.
Practical-19.	Develop a program to dynamically resize an array as elements are added or removed.
Practical-20.	Implement a function to concatenate two strings without using library functions.
Practical-21.	Create a program to manage employee records using structures.
Practical-22.	Implement a program to store and retrieve student details using file handling.
Practical-23.	Write a program to copy contents from one file to another.
Practical-24.	Create a payroll system that calculates and displays employee salaries, storing the data in files.
Practical-25.	Implement an inventory management system to track products using structures and file handling.
Practical-26.	Develop a program to manage patient records using structures and files.
Practical-27.	Create a program to demonstrate file error handling techniques.
Practical-28.	Write a program to generate student grade reports and save them in a file.
Practical-29.	Implement a singly linked list with operations like insertion, deletion, and traversal.
Practical-30.	Create a program to implement stack operations using arrays and linked lists.
Practical-31.	Develop a program to simulate a queue using arrays and linked lists.
Practical-32.	Write a program to count the number of words in a text file.
Practical-33.	Implement a program using macros for basic arithmetic calculations.
Practical-34.	Develop a program to recursively list all files in a directory (if operating system access is allowed).
Practical-35.	Implement a basic Sudoku solver using backtracking and recursion.
Practical-36.	Develop a comprehensive project simulating bank transactions including account creation, deposit, withdrawal, and balance inquiry, integrating structures, file handling, and dynamic memory allocation.

Text Books:

1. *Computer Programming with C, Special Edition-MRCET, Mc Graw Hill Publishers 2017,*
2. *Computer Science: A Structured Programming Approach Using C, B, A, Forouzan and R, F, Gilberg, Third Edition, Cengage Learning,*

Reference Books:

1. *The C Programming Language, B, W, Kernighan and Dennis M, Ritchie, PHI*
2. *Computer Programming, E, Balagurusamy, First Edition, TMH*
3. *C and Data structures – P, Padmanabham, Third Edition, B, S, Publications,*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Able to develop programs that perform fundamental arithmetic operations	**L2 & L3**
CO-2	Ale to use arrays, pointers, and structures by creating programs for matrix multiplication, student mark storage, employee records management, and dynamically resizing arrays	**L3 &L4**
CO-3	Able to implement recursive functions, linear and binary search algorithms	**L1& L3**
CO-4	will learn to manage data using file handling techniques, including storing and retrieving student details, copying file contents, generating grade reports, and handling file errors, essential for real-world applications	**L2 & L3**
CO-5	will apply their theoretical knowledge to practical, real-life scenarios, integrating multiple programming concepts seamlessly	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	1	0	0	0	1	2	3
CO-2	3	3	3	2	1	1	0	0	0	1	1	3
CO-3	3	3	3	3	1	0	0	0	0	0	1	3
CO-4	3	3	3	2	21	1	0	0	0	1	2	3
CO-5	3	3	3	3	2	1	0	0	0	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I/II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: PROFESSIONAL COMMUNICATION LAB**
Course Code: ENAS-114P/ ENAS-124P	**Title: PROFESSIONAL COMMUNICATION LAB**

Course Objectives:

1. To enhance students' ability to communicate effectively in social and professional settings
2. To focus on the correct pronunciation and intonation patterns of English to ensure clear and understandable speech
3. To provide a solid foundation in English grammar and expand vocabulary for more accurate and expressive language use
4. To develop active listening skills and improve comprehension abilities through focused practice and exercises
5. To equip students with essential soft skills such as interview handling, email etiquette, and presentation skills to succeed in professional environments.

Nature of Paper: AECC (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0	T: 0	P: 2	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title(English-Wordsworth-Language Lab)
Module-1.	**Communication Skills –** 1. Social Meeting People & Asking Questions 2. Making Friends 3. Dos & Don'ts 4. What do you do?
Module-2.	**English Concepts –** 1. Tenses 2. Parts of Speech 3. Figures of Speech 4. Direct & Indirect Speech
Module-3.	**Pronunciation –** 1. Phonetics & Intonations 2. Vowels, Consonants, Nouns
Module-4.	**Communication Skills –** 1. Listening Skills 2. Speaking Skills

	3. Reading Skills 4. Writing Skills
Module-5.	**Advance Learning & Soft Skills –** 1. Effective Communication 2. Interview Handling Skills 3. Email Etiquette 4. Presentation Skills 5. Listening Comprehension

Text Books/Reference Books:

1. *Daniel Jones: English Pronouncing Dictionary*
2. *R.K. Bansal: Phonetics in English*
3. *Sethi and Dhamija: A Course in English Phonetics*
4. *S.D. Sharma: A Text-Book of Professional Communication & ESP*
5. *S.D. Sharma: Manual on Communication Lab English*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Students will demonstrate improved ability to meet and engage with people, make friends, and handle social interactions confidently and appropriately	**L2 & L3**
CO-2	Students will exhibit correct pronunciation, intonation, and the ability to articulate vowels, consonants, and nouns clearly	**L3 &L4**
CO-3	Students will show proficiency in using tenses, parts of speech, and figures of speech in both written and spoken English	**L1& L3**
CO-4	Students will display heightened listening skills and the ability to comprehend and respond accurately to spoken and written English	**L1 & L4**
CO-5	Students will be able to effectively manage interviews, compose professional emails, and deliver impactful presentations, showcasing their preparedness for professional scenarios	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	1	0	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	2	2	1	0	0	0	0	1	2
CO-3	0	2	2	2	1	0	0	0	0	0	1	2
CO-4	1	3	2	2	2	0	0	0	0	0	1	1
CO-5	1	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: ELECTRONICS IN THE MODERN WORLD LAB**
Course Code: ENEE-121P	**Title: ELECTRONICS IN THE MODERN WORLD LAB**

Course Objectives:

1. To analyze a given network by applying various electrical laws.
2. To analyze a given network by applying various electrical network theorems
3. To know the response of electrical circuits for different excitations
4. To calculate, measure and know the relation between basic electrical parameters
5. To calculate, measure and know the relation between basic electronics parameters

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & (50% of External Assessment)

L: 0	**T:** 0	**P:** 2	**C:** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Verification of Ohms Law.
Practical-2.	Verification of KCL and KVL for DC Circuits.
Practical-3.	Verification of Superposition Theorem.
Practical-4.	Verification of Thevenin`s Theorem
Practical-5.	Verification of Norton`s Theorem
Practical-6.	Verification of Maximum Power Transfer Theorem
Practical-7.	Calculations and Verification of Impedance and Current of RL, RC and RLC series Circuits.
Practical-8.	Measurement of Voltage, Current and Real Power in primary and Secondary AC Circuits
Practical-9.	The identification & Testing of Electronic component.
Practical-10.	Diode Characteristics (Si) a) Forward Bias b) Reverse Bias
Practical-11.	Study and analysis of half Wave rectifier with & without filter.
Practical-12.	Study and analysis of full Wave rectifier with & without filter.
Practical-13.	Transistor CE Characteristics (I/P & O/P)

Text Books:

1. Robert L. Boylestand / Louis Nashelsky "Electronic Devices and Circuit Theory", Pearson Education.
2. R. Muthusubramanian, S. Salivahanan, "Basic Electrical and Electronics Engineering", Tata McGraw-Hill Education, Reprint 2012
3. George Kennedy, "Electronic Communication Systems", McGraw Publication

Reference Books:

1. David A. Bell, "Electronic Devices and Circuits", Oxford University Press.
2. Jacob Millman, C.C. Halkias, StayabrataJit, "Electronic Devices and Circuits", McGraw Hill
4. David A. Bell, Electronic Instrumentation and Measurements, Latest Edition, Oxford Uni Press India

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3)External Practical Assessment	External Assessment	20
4)Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Create basic electrical connections for domestic applications	**L2 & L3**
CO-2	Measure the various electrical parameters in the DC circuit	**L3 &L4**
CO-3	Measure the various electrical parameters in the AC circuit	**L1& L3**
CO-4	To study basic electronic components.	**L2 & L3**
CO-5	To get the practical expose of the Transistors applications.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	2	2	1	0	0	0	0	1	2
CO-3	3	3	2	2	1	0	0	0	0	0	1	2
CO-4	3	3	2	2	2	0	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: ELECTRICAL & ELECTRONICS IN THE MODERN WORLD**
Course Code: ENEE-121	**Title: ELECTRICAL & ELECTRONICS IN THE MODERN WORLD**

Course Objectives:
1. To provide students with a foundation in basic electrical and electronic principles.
2. To develop the ability to simplify complex DC networks
3. To introduce semiconductors and devices used in computers and modern electronics.
4. To connect electronics concepts with applications in computing, IoT, and automation.
5. To enable students to perform simple hands-on experiments using electronic components and microcontrollers.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	**T:** 1	**P:** 0	**C:** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Fundamentals of Electrical & Circuits** • Voltage, current, resistance, power (basic quantities) • Passive Components: Resistors, capacitors, inductors: functions, uses, and color coding • Ohm's Law and simple circuit calculations • Series and parallel combination of resistance, • AC vs DC supply (very basic introduction) • Application: Power supply in computers, mobile	9L
II	**DC Circuits** • Introduction to DC circuits, • Star-Delta conversion. • Kirchhoff's laws, • Mesh and nodal methods of analysis, • DC theorems: Thevinen's Theorem Norton's theorem, Maximum Power Transfer Theorem,	9L
III	**Introduction to Electronics: Semiconductor Basics & Devices** • Difference between electrical and electronics • Role of electronics in computing, communication, healthcare, and	9L

	automation • Conductors, semiconductors, insulators • Intrinsic & extrinsic semiconductors (p-type, n-type – simple explanation) • Active Components: Diodes, transistors, LEDs, ICs • PN junction diode: forward/reverse bias, • Transistors: concept as switch & amplifier	
IV	**Digital Electronics & Logic** • Binary number systems & voltage levels (0s and 1s) • Logic gates: AND, OR, NOT, NAND, NOR (truth tables & symbols) • Simplification of Boolean functions using K- Mapp (Upto 4 variables) • Simple combinational logic (half adder, encoder/decoder – basic idea)	**9L**
V	**Electronics in the Modern World** • Motherboards, chipsets, RAM, processors (basic blocks) • Consumer electronics: smartphones, smart TVs, laptops • Computer hardware: power supply, microprocessor basics • IoT and Embedded Systems: microcontrollers (Arduino, Raspberry Pi), sensors & actuators • Applications in automation, wearables, renewable energy devices • Emerging technologies: AI chips, quantum computing (intro only)	**9L**

Text Books:

1. Robert L. Boylestand / Louis Nashelsky "Electronic Devices and Circuit Theory", Pearson Education.
2. R. Muthusubramanian, S. Salivahanan, "Basic Electrical and Electronics Engineering", Tata McGraw-Hill Education, Reprint 2012
3. George Kennedy, "Electronic Communication Systems", McGraw Publication

Reference Books:

1. David A. Bell, "Electronic Devices and Circuits", Oxford University Press.
2. Jacob Millman, C.C. Halkias, Stayabrata Jit, "Electronic Devices and Circuits", McGraw Hill
3. David A. Bell, Electronic Instrumentation and Measurements, Latest Edition, Oxford Uni Press India

If the course is available as **Generic Elective**, then the students of following departments may opt it: NO

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Physics of Class 12

Course Learning Outcomes:

CO-1	Apply the fundamental laws of electricity and circuit analysis to solve basic	**L2 & L3**

	AC/DC circuit problems.	
CO-2	**Analyze** DC circuits using Kirchhoff's laws, network theorems, and circuit simplification methods.	**L3 &L4**
CO-3	**Explain** the working of semiconductor devices and their applications in switching and amplification.	**L1& L3**
CO-4	**Demonstrate** the use of digital electronics concepts including number systems, logic gates, and basic combinational circuits.	**L2 & L3**
CO-5	**Recognize** modern electronic systems, IoT devices, and emerging technologies in computing and automation.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: Introduction to CNC and 3-D Printer Lab**
Course Code: ENME-123P	**Title: Introduction to CNC and 3-D Printer Lab**

Course Objectives:

1. Understanding CNC and 3D Printing Technologies
2. Gain hands-on experience with CNC machines and 3D printers, including setup, operation, maintenance, and troubleshooting.
3. Identify and select appropriate materials for CNC machining and 3D printing based on their properties and application requirements.
4. Apply quality control methods and standards to ensure the production of high-quality parts.\
5. Explore the diverse industry applications of CNC machining and 3D printing, including automotive, aerospace, healthcare, and consumer products

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Marks (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Overview of CNC machine components and functions.
Practical-2.	Introduction to G-code and M-code.
Practical-3.	Writing simple CNC programs for basic shapes (e.g., square, circle).
Practical-4.	Loading and securing the workpiece along with tool selection and tool path setup.
Practical-5.	Programming and executing 2D milling operations to Creating a flat surface, slot, and pocket milling.
Practical-6.	Overview of CNC lathe operations along with programming and executing turning operations (e.g., facing, turning, threading).
Practical-7.	Introduction to CNC simulation software and Simulating CNC programs to verify tool paths and operations.
Practical-8.	Overview of 3D printing technology and applications along with Safety procedures and lab protocols.
Practical-9.	Understanding the parts of a 3D printer. With Basics of printer maintenance and troubleshooting. .
Practical-10.	Introduction to CAD software (e.g., Tinkercad, Fusion 360).

Practical-11.	Designing simple 3D models for printing.
Practical-12.	Introduction to slicing software (e.g., Cura, Prusa Slicer).
Practical-13.	Developing a small project that incorporates both CNC and 3D printing techniques

Reference/Text Books:

1. *"CNC Programming" S K Sinha*
2. *" Functional Design for 3D" by Mr Clifford T Smyth*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3)External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Understanding CNC and 3D Printing Technologies	**L2 & L3**
CO-2	Gain hands-on experience with CNC machines and 3D printers, including setup, operation, maintenance, and troubleshooting.	**L3 &L4**
CO-3	Understand the properties and selection criteria of various materials used in CNC machining and 3D printing	**L1& L3**
CO-4	Develop skills in designing 3D models suitable for CNC machining and 3D printing, including considerations for manufacturability and printability.	**L2 & L3**
CO-5	Understand quality control methods and standards for parts produced by CNC machining and 3D printing.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I/II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: Mechanical Workshop Lab**
Course Code: ENME-112P/ENME-122P	**Title: Mechanical Workshop Lab**

Course Objectives:
1. To understand the importance of tools used in workshop.
2. To prepare various joints used in workshop.
3. To identify & apply the most appropriate tools for various applications.
4. To perform the various types of black smithy and sheet metal shop operations.
5. Introduce students to the fundamentals of Computer Numerical Control (CNC) machines, including their components, operation principles, and applications in modern manufacturing.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 3	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Module-1	**Carpentry Shop:** **Practical-1:** To prepare half-lap corner joint. **Practical-2:** To prepare mortise & Tenon joint. **Practical-3:** To prepare a cylindrical pattern on woodworking lathe
Module-2	**Fitting Bench Working Shop:** **Practical-1:** To prepare a V-joint fitting **Practical-2:** To prepare a U-joint fitting **Practical-3:** To make a perfect square job
Module-3	**Black Smithy Shop:** **Practical-1:** To prepare a square rod from given circular rod. **Practical-2:** To prepare a square S- shape from given circular rod. **Practical-3:** To prepare a nail from given circular rod.
Module-4	**Welding Shop:** **Practical-1:** To prepare a butt welded joints using arc welding machine. **Practical-2:** To prepare a "T" welded joints using MIG welding machine. **Practical-3:** To prepare a Lap welded joint using resistance spot welding machine.
Module-5	**Sheet-metal Shop:** **Practical-1:** To make round duct of GI sheet using 'soldering' process. **Practical-2:** To prepare a tray of GI by fabrication

Module-6	**Machine Shop:** **Practical-1:** To prepare a bolt on the lathe machine as per given. Diagram. **Practical-2:** To prepare a slot on the horizontal milling machine as per given diagram.
Module-7	**Foundry Shop:** **Practical-1:** To prepare core as per given size. **Practical-2:** To prepare a mould for given casting.
Module-8	**CNC Shop:** **Practical-1:** Learn about the components of a CNC machine and their functions. **Practical-2:** Learn how to set up a work piece in the CNC machine (fixturing, tooling, work holding). **Practical-3:** Understand the process of loading tools into the machine and tool length offsets. **Practical-4:** Mount the cutting tool on the tool post and set its position relative to the work piece. **Practical-5:** To prepare a turning job on a CNC lathe machine according to a given diagram.

Reference/Text Books:

1. *A Course In Workshop Technology (Manufacturing Processes Vol. 1, B.S. Raghuwanshi, Publisher, Dhanpat Rai & Co.*
2. *Manufacturing Processes, Kumar & Gupta, Prentice Hall India.*
3. *Production Technology, Jain, Khanna Publications.*
4. *CNC Machining for Beginners by Paul Smith*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce (External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Understand the tools used in workshop & their applications.	**L2 & L3**
CO-2	Prepare various joints used in carpentry, fitting and welding shop.	**L3 &L4**
CO-3	Identify & apply the most appropriate tools for various manufacturing operations like turning, facing and threading.	**L1& L3**
CO-4	Perform the various types of black smithy and sheet metal shop operations.	**L2 & L3**
CO-5	Students will demonstrate proficiency in setting up CNC machines, loading programs, and executing machining operations to achieve specified dimensions and tolerances.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	0	3	0	0	0	1	0	0	2	1
CO-2	0	3	3	3	0	1	3	1	1	1	2	1
CO-3	0	2	2	2	3	2	0	0	0	2	2	2
CO-4	0	2	2	1	2	1	0	0	0	0	3	1
CO-5	1	2	1	1	1	0	0	0	0	0	0	0

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I/II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: Engineering Graphics & Design Lab**
Course Code: ENME-113P/ ENME-123P	**Title: Engineering Graphics & Design Lab**

Course Objectives:

1. To study the standard and rules to be trailed by engineers for making precise drawings.
2. To understand the fundamental dimensioning practices that must be continued in the arrangement of drawings.
3. To draw the various types of projection of lines, planes and solids.
4. To apply the CAD for design.
5. To create the engineering models.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 1

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Introduction to Engineering Drawing, Orthographic Projections: Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain and Diagonal Scales. Principles of Orthographic Projections – Conventions – Projections of Points and Lines inclined to both planes; Projections of planes inclined Planes – Auxiliary Planes.
Practical-2.	Projections and Sections of Regular Solids: Sections in lined to both the Planes – Auxiliary Views; Simple annotation, dimensioning and scale. Floor plans they include: windows, doors. Prism, Cylinder, Pyramid, Cone – Auxiliary Views.
Practical-3.	Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conversions.
Practical-4.	Computer Graphics: Listing the computer technologies the impact on graphical communication, Demonstration knowledge of the theory of CAD software [such as: The Menu System, Tollbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects: Isometric Views of lines, Planes, Simple and compound Solids];
Practical-5.	Set up of the drawing page and the printer, including scale settings, Setting up of units

	and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen), Computer-aided design (CAD) software modeling of parts and assemblies.

Reference/Text Books:

1. Engineering Drawing, Bhatt N.D., Panchal V.M. & Ingle P.R. (2014), Charotar Publishing House.
2. Engineering Drawing, Narayana, K.L. & P Kannaiah (2008), Scitech Publishers.
3. Engineering Drawing Paperback, P.S. Gill (Author), S.K. Kataria & Sons.
4. Engineering Drawing and Computer Graphics, Shah, M.B. & Rana B.C. (2008), Pearson Education.
5. Engineering Graphics, Agrawal B. & Agrawal C.M. (2012), TMH Publication.
6. Engineering Graphics & Design, A.P. Gautametc, Khanna Publishing House.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce (External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Understand the basic concepts and principles of engineering graphics and their significance.	**L2 & L3**
CO-2	Understand the theory of projections and regular solids.	**L3 &L4**
CO-3	Draw the various types of projection of lines, planes and solids.	**L1& L3**
CO-4	Apply the CAD for design.	**L2 & L3**
CO-5	Creating the engineering models using solid modeling.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	0	0	0	0	1	0	0	0	2	0	0
CO-2	3	2	0	0	0	1	0	0	0	0	0	0
CO-3	3	0	3	0	1	0	0	0	0	2	0	0
CO-4	2	0	2	0	3	0	0	0	0	1	0	0
CO-5	2	0	3	1	3	0	0	0	0	0	2	0

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: II**
Credits: NA **Theory: 0** **Practical: 0**	**SUBJECT: SPIRITUAL AND CULTURAL HERITAGE: INDIAN EXPERIENCE**
Course Code: ENPH-111	**TITLE: SPIRITUAL AND CULTURAL HERITAGE: INDIAN EXPERIENCE**

Course Objectives:

1. To provide an overview of the foundations of Indian knowledge systems through the Vedas, Upanishads, epics, and traditional sciences.
2. To develop appreciation for India's rich heritage in art, architecture, literature, and languages.
3. To introduce the major Indian philosophical schools and contributions of spiritual thinkers.
4. To foster understanding of cultural identity and values rooted in Indian traditions
5. To highlight the modern relevance and global impact of Indian knowledge and heritage.

Nature of Paper: Audit Course (Lab)

Minimum Passing Marks/Credits: NA

L :	T : 0	P : 2	C : 0

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to Indian Knowledge Systems and Cultural Identity	**4L**
II	Vedas, Upanishads, Epics and Traditional Indian Sciences	**4L**
III	Art, Architecture, Literature and Languages of India	**4L**
IV	Indian Philosophical Schools and Spiritual Thinkers	**4L**
V	Modern Relevance and Global Impact of Indian Heritage	**4L**

Text Books:

1. The Essentials of Indian Philosophy by M. Hiriyanna. Motilal Banarsidass
2. Indian Philosophy by S. Radhakrishnan, Oxford University Press.
3. India: A Sacred Geography by Diana L. Eck. Three Rivers Press
4. The Wonder That Was India **by** A.L. Basham, Picador.
5. Cultural Heritage of India (Vols 1–5) by Ramachandra Rao, Bharatiya Vidya Bhavan

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	NA
2) Presentations /Seminar	25
3) Assignments	NA

4) Research Project Report Seminar On Research Project Report	NA
5) ESE	NA
Total:	**NA**

Prerequisites for the course: NA

Course Learning Outcomes:

CO-1	Recognize the diversity and unity of Indian cultural traditions.	**L2 & L4**
CO-2	Understand the philosophical and spiritual essence of Indian scriptures.	**L3 &L4**
CO-3	Analyze the contributions of Indian heritage to global knowledge systems.	**L3 & L4**
CO-4	Appreciate art, literature, architecture and their cultural context.	**L2 & L3**
CO-5	Develop respect for Indian values, thought, and wisdom traditions.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	1	0	1	0	1	0	0	0	0	0	0	0
CO-2	0	1	1	1	1	1	0	0	0	0	0	0
CO-3	1	1	0	1	0	0	0	0	0	0	0	0
CO-4	0	0	0	1	1	1	0	0	0	0	0	0
CO-5	0	1	1	0	0	1	0	0	0	0	0	0

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**	**Year: I** **Semester: II**
Credits: NA **Theory: 0** **Practical: 0**	**Subject: APPLIED DIFFRENTIAL EQUATIONS**
Course Code: ENAS-121	**Title: APPLIED DIFFRENTIAL EQUATIONS**

Course Objectives:

1. To understand the effective mathematical tools for the solutions of differential equations that model physical processes.
2. To get the idea of types of partial differential equations and their solutions.
3. To understand the concept of Laplace Transform and its application to solve differential and integral equations.
4. To understand and apply the foundational knowledge and analytical skills of Fourier series in solving engineering problems.
5. To equip students with the knowledge and skills to formulate and solve linear programming problems for optimal decision-making in engineering applications.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: NA

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**ORDINARY DIFFERENTIAL EQUATIONS:** Linear differential equation of nth order with constant coefficients, Simultaneous linear differential equations, Second order linear differential equations with variable coefficients, Solution by changing independent variable, Reduction of order, Normal form, Method of variation of parameters, Cauchy-Euler equation.	9L
II	**PARTIAL DIFFERENTIAL EQUATIONS:** Origin of Partial Differential Equations, Linear and Non Linear Partial Equations of first order, Lagrange's Equations, Charpit's method, Solution of Linear Partial Differential Equation of Higher order with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients.	9L
III	**LAPLACE TRANSFORM:** Laplace transform, Existence theorem, Laplace transforms of derivatives and integrals, Initial and final value theorems, Unit step function, Dirac- delta function, Laplace transform of periodic function, Inverse Laplace transform, Convolution theorem, Application to solve simple linear and simultaneous differential equations.	9L

IV	**FOURIER SERIES:** Euler's Formulae, Functions having arbitrary periods,πPeriodic functions, Fourier series of period 2 Change of interval, Even and odd functions, Half range sine and cosine series.	**9L**
V	**Linear Programming and Optimization:** Definition and importance of Linear Programming in engineering and optimization, Real-life applications of Linear Programming in various fields, Formulation of Linear Programming Problems, Solution of Linear Programming Problems using the Graphical Method, Simplex Method, Concept of duality in Linear Programming, Dual Simplex Method.	**9L**

Text Books:

1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*
4. *S.D. Sharma, Operation Research, Kedar Nath Ram Nath Publications*

Reference Books:

1. *E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.*
2. *Veerarajan T., Engineering Mathematics for first year, McGraw-Hill, New Delhi, 2008.*
3. *R K. Jain & S R K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House 2002*
4. *H.A. Taha, Operation Research-An introduction, Printice Hall of India*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Engineering Mathematics-I (RTAS-111)

Course Learning Outcomes:

CO-1	to solve linear differential equations of nth order with constant coefficients, and apply methods to solve various types of differential equations including Cauchy-Euler equations.	**L2 & L4**
CO-2	to formulate and solve first and higher-order partial differential equations using methods like Lagrange's equations, Charpit's method	**L3 &L4**
CO-3	demonstrate proficiency in using Laplace transforms to solve differential equations using theorems related to initial and final values, convolution, and the inverse Laplace transform.	**L3 & L4**
CO-4	able to represent periodic functions using Fourier series, understand and apply Euler's formulas, and construct Fourier series for functions of arbitrary periods and half-range expansions, identifying even and odd functions.	**L2 & L3**

CO-5	will develop the ability to formulate linear programming problems, solve them and understand the concept of duality in linear programming, with applications to real-life optimization problems in various fields.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	3	2	2	2	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	3	3	2	0	0	0	0	0	1	3
CO-4	3	3	2	3	2	1	0	0	0	0	1	2
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**	**Year: I** **Semester: II**
Credits: NA **Theory: 0** **Practical: 0**	**SUBJECT: HEALTH AND WELLNESS**
Course Code: ENHW-121	**TITLE: HEALTH AND WELLNESS**

Course Objectives:

1. To introduce the concept and dimensions of health and wellness for a balanced lifestyle.
2. To develop awareness about nutrition, physical activity, and preventive measures against lifestyle diseases.
3. To promote mental and emotional well-being through stress management, mindfulness, and emotional intelligence.
4. To create awareness about substance abuse, its health risks, and strategies for prevention.
5. To educate students on public health practices, hygiene, first-aid, and digital wellness.

Nature of Paper: Audit Course (Lab)

Minimum Passing Marks/Credits: NA

L :	T : 0	P : 2	C : 0

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to Health and Wellness: Definition and dimensions of health, importance of wellness, lifestyle diseases and their prevention.	4L
II	Nutrition and Physical Activity: Basics of a balanced diet, nutrients and their sources, physical activity guidelines, benefits of exercise and yoga.	4L
III	Mental and Emotional Well-being: Understanding stress, coping mechanisms, emotional intelligence, mindfulness practices, importance of sleep.	4L
IV	Substance Abuse and Health Risks: Awareness about tobacco, alcohol, drugs; addiction prevention; understanding peer pressure and making informed choices.	4L
V	Public Health and Digital Wellness: Hygiene and sanitation, preventive healthcare, first-aid basics, digital wellness, screen time management, online health resources.	4L

Text Books:

1. Textbook of Health and Physical Education by Dr. V.K. Sharma, Saraswati House
2. Health and Wellness by Dr. Anjali Arora. Penguin Books India
3. The Wellness Sense by Om Swami, Jaico Publishing House
4. Essentials of Physical Education by K. Goel, Goyal Brothers Prakashan
5. Fitness and Wellness by Wener W.K. Hoeger & Sharon A. Hoeger, Cengage Learning

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	NA
2) Presentations /Seminar	25
3) Assignments	NA
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	NA
Total:	**NA**

Prerequisites for the course: NA

Course Learning Outcomes:

CO-1	Understand the importance of holistic health and identify factors affecting wellness.	**L2 & L4**
CO-2	Apply principles of nutrition and physical fitness for a healthy lifestyle.	**L3 &L4**
CO-3	Demonstrate awareness of mental and emotional health practices.	**L3 & L4**
CO-4	Recognize harmful substances and develop resistance to negative peer influence.	**L2 & L3**
CO-5	Practice good hygiene and digital wellness using available health resources.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	1	0	1	0	1	0	0	0	0	0	0	0
CO-2	0	1	1	1	1	1	0	0	0	0	0	0
CO-3	1	1	0	1	0	0	0	0	0	0	0	0
CO-4	0	0	0	1	1	1	0	0	0	0	0	0
CO-5	0	1	1	0	0	1	0	0	0	0	0	0

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Fundamental Concepts and Problem Solving with Python**
Course Code: ENCS-121	**Title: Fundamental Concepts and Problem Solving with Python**

Course Objectives:
1. To be able to introduce core programming basics.
2. To understand a range of Object-Oriented Programming, as well as in-depth data and information processing techniques.
3. To understand data types, statement, operators, modules, list, tuple, and dictionaries.

Nature of Paper: VAC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Python Programming:** History and evolution of Python, Features and advantages, Installation and setup (Python IDEs, Jupyter Notebook, Anaconda) **Basic Syntax:** Python syntax and semantics, Writing and executing a Python script, Indentation and code structure **Data Types and Variables:** Basic data types (int, float, str, bool), Variable declaration and assignment, Type conversion and casting **Operators and Expressions:** Arithmetic, relational, logical, and bitwise operators, Operator precedence and associativity.	9L
II	**Control Structures and Functions:** **Control Flow Statements:** Conditional statements (if, if-else, nested if-else), Looping statements (for, while, nested loops), Control statements (break, continue, pass), **Functions:** Defining and calling functions, Function arguments and return values, Recursion, Lambda functions and anonymous functions, **Modules and Packages:** Importing modules and using standard libraries, Creating and using custom modules, Introduction to virtual environments	9L
III	**Data Structures in Python:** **Strings:** String operations and methods, String formatting and manipulation, **Lists:** List operations and methods, List comprehensions, Nested lists, **Tuple:** Tuple operations and methods, Advantages of using tuples,	9L

	Dictionaries: Dictionary operations and methods, Dictionary comprehensions, Nested dictionaries, **Sets:** Set operations and methods, Set theory operations (union, intersection, difference)	
IV	**Problem Solving and File Handling:** **Problem Solving Techniques:** Algorithm design and pseudocode, Flowcharts, Debugging and testing, Exception handling (try, except, finally) **File Handling:** Reading from and writing to files, File methods and operations (open, close, read, write, append), Working with CSV and JSON files **Regular Expressions:** Introduction to regular expressions, Using the **re** module for pattern matching	**9L**
V	**Advanced Topics and Future Technologies:** **Object-Oriented Programming (OOP):** Classes and objects, Inheritance, polymorphism, encapsulation, and abstraction, Magic methods and operator overloading **Introduction to Data Science:** Basics of NumPy and Pandas, Data analysis and manipulation, Visualization with Matplotlib and Seaborn. **Future Prospects:** Career opportunities and industry trends, Ethical considerations in technology	**9L**

Text Books:
1. Python Crash Course.
2. Head-First Python, 2nd edition

Reference Books:
1. Guido van Rossum, and Fred L. Drake, Jr. (Editor)ISBN: 1906966141
2. Network Theory Ltd, 120 pages (Revised November 2006)

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	**Max. Marks**
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: solid computer literacy.

Course Learning Outcomes:

CO-1	To define the structure and components of a Python program.	**L2 & L3**
CO-2	To learn how to build and package Python modules for reusability.	**L3 &L4**
CO-3	To learn how to write functions and pass arguments in Python.	**L1& L3**
CO-4	To learn how to read and write files in Python.	**L2 & L3**
CO-5	To learn how to design object-oriented programs with Python classes.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)												
CO-PO Mapping												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	1	0	3	0	0	0	0	0	0	1
CO-2	3	2	2	0	3	0	0	0	0	0	1	2
CO-3	3	3	2	0	3	0	0	0	0	0	0	2
CO-4	3	3	1	0	3	0	0	0	0	0	1	2
CO-5	3	3	3	0	3	2	0	0	0	0	2	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**	**Year: I** **Semester: II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: Fundamental Concepts and Problem Solving with Python Lab**
Course Code: ENCS-121P	**Title: Fundamental Concepts and Problem Solving with Python Lab**

Course Objectives:

1. Develop proficiency in writing and executing basic Python programs
2. Implement core programming concepts including conditional statements, loops, and functions through practical tasks
3. Enhance problem-solving skills by tackling tasks such as swapping values without a third variable
4. Gain a strong grasp of data structures like lists, tuples, and dictionaries, and practice algorithms for operations like merging sorted lists, removing duplicates, and counting specific elements
5. Explore advanced Python features and libraries by creating classes, utilizing random functions

Nature of Paper: VAC (Lab)

Minimum Passing Marks/Credits: 50% marks / 1 Credits (50% of Internal Assessment&50% of External Assessment)

L: 0	**T:** 0	**P:** 2	**C:** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	**Practical Title**
Practical-1.	Write a Python program to print "Hello, World!".
Practical-2.	Implement a calculator that can perform addition, subtraction, multiplication, and division.
Practical-3.	Determine if a given year is a leap year.
Practical-4.	Swap the values of two variables without using a third variable.
Practical-5.	Check if a given string is a palindrome.
Practical-6.	Determine the maximum of three given numbers.
Practical-7.	Check if a number is an Armstrong number.
Practical-8.	Merge two sorted lists into a single sorted list.
Practical-9.	Remove duplicate elements from a list.
Practical-10.	Python program to count positive and negative numbers in a list.
Practical-11.	Python Program to Accept the Strings Which Contains all Vowels.
Practical-12.	Write a python Programming to find Maximum record value key in dictionary
Practical-13.	Python program to find tuple which have all elements divisible by K from a list of tuple

Practical-14.	Write a Python program to create a calculator class. Include methods for basic arithmetic operations.
Practical-15.	Write a Python function to find the maximum of three numbers.
Practical-16.	Write a Python program to select a random element from a list, set, dictionary-value, and file from a directory. Use random. Choice().
Practical-17.	Write a Python program to check if a function is a user-defined function or not. Use types. Function Type, types. Lambda Type().

Reference/Text Books:

- *Guido van Rossum, and Fred L. Drake, Jr. (Editor)ISBN: 1906966141*
- *Network Theory Ltd, 120 pages (Revised November 2006)*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	To Understand basic syntax of python implementation	**L2 & L3**
CO-2	To practically apply looping and conditional constructs	**L3 &L4**
CO-3	To implement program related with list data structure	**L1& L3**
CO-4	To implement various searching algorithm in python	**L2 & L3**
CO-5	To implement list, tuple, dictionary and modules	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	1	2	1	3	1	1	1	1	1	1	1
CO-2	3	2	2	2	3	1	1	1	2	1	1	2
CO-3	3	3	2	2	3	1	1	1	2	1	1	2
CO-4	3	2	2	2	3	1	1	1	2	1	1	2
CO-5	3	2	2	3	3	1	1	1	2	1	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**	**Year: I** **Semester: II**
Credits: NA **Theory: 0** **Practical: 0**	**Subject: Sports**
Course Code: SPT-PC-111	**Title: Sports**

Course Objectives: The objectives of studying this course are

1. To develop students' physical fitness, mental well-being, and proficiency in various individual and team sports through structured participation and practice.
2. To foster qualities of discipline, teamwork, sportsmanship, and strategic thinking by engaging students in competitive and recreational games and physical activities.

Nature of Paper: Core (Practical)

Minimum Passing Marks/Credits: NA

L: 0	**T:** 0	**P:** 2	**C:** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

S.No.	Contents	No. of Lectures Allotted
1	Archery/ Athletics/ Badminton/ Basketball/ Boxing/ Carrom/ Chess/ Cricket/ Football/ Handbal/l Judo/ Kabaddi/ Kho-Kho/ Martial Arts/ Powerlifting/ Table/ Tennis/ Volleyball/ Weightlifting/ Wrestling/ Yoga.	2L

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	15
2) Presentation/Seminar/Viva-Voce(Internal)		-
3) External Practical Assessment	External Assessment	35
4) Presentation/Seminar/Viva-Voce(External)		-
5) Practical Records		-
Total:		**50**

Prerequisites for the course: NA

Course Learning Outcomes:

CO-1	Demonstrate basic skills, rules, and techniques required for effective participation in individual sports such as athletics, archery, boxing, and martial arts.	**L3**

CO-2	Exhibit proficiency in team-based sports like football, basketball, volleyball, kabaddi, and kho-kho, with emphasis on coordination, communication, and team strategy	**L3, L4**
CO-3	Analyze and apply rules, scoring systems, and tactics in indoor games such as chess, carrom, and table tennis to enhance cognitive and decision-making skills.	**L4**
CO-4	Develop and maintain physical fitness, flexibility, and endurance through regular practice and participation in strength-based and aerobic activities such as yoga, powerlifting, and athletics	**L3**
CO-5	Demonstrate sportsmanship, ethical behavior, self-discipline, and leadership qualities both during practice and competitive events.	**L3,L5**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	2	1	2	1	1	–	–	–	2	1	–	2
CO-2	–	1	2	–	–	–	–	–	3	2	2	2
CO-3	1	2	–	–	1	–	–	2	2	2	–	2
CO-4	–	–	–	2	–	–	2	–	1	1	–	3
CO-5	–	–	–	–	–	3	–	3	3	2	3	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech EE/EEE**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Engineering Mathematics-III**
Course Code: RTAS-231	**Title: Engineering Mathematics-III**

Course Objectives: The objectives of studying this course are,
1. To make the students familiar with complex functions and its calculus.
2. To deal with applications, residues and conformal mapping.
3. To understand the concept and applications of integral transforms.
4. To deal with numerical solutions of algebraic equations and differential equations.
5. To understand the statistical aspect of functions.

Nature of Paper: Core (Theory)

Minimum Passing Marks: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	**T:** 1	**P:** 0	**C:** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Functions of a Complex Variable I**: Analytic functions; C-R equations and harmonic functions; Line integral in the complex plane; Cauchy's integral theorem, Cauchy's integral formula for derivatives of analytic functions; Liouvilles theorem.	9L
II	**Functions of a Complex Variable II**: Representation of a function by power series; Taylor's and Laurent's series; Singularities, zeroes and poles; Residue theorem, evaluation of real integrals; conformal mapping and bilinear transformations.	9L
III	**Integral Transforms:** Fourier integral, Fourier complex transform, Fourier sine and cosine transforms and applications to simple heat transfer equations. Z – Transform and its application to solve difference equations.	9L
IV	**Numerical Techniques:** Solution of polynomial and transcendental equations Bisection method, Regula – Falsi method, Newton - Raphson method. **Interpolation:** Finite difference, Newton's forward and backward interpolation, Lagrange's and Newton's divided difference formula for unequal intervals; **Numerical Differentiation**, **Numerical Integration**; Trapezoidal, Simpson's 1/3 and 3/8 rules. **Numerical solutions of first order differential equations** by Euler's method and 4th order Runge-Kutta method.	9L
V	**Statistical Techniques:** Moments, Moment generating functions, Skewness,	9L

	Kurtosis, Curve Fitting and Solution of Equations: Method of least squares and curve fitting of straight line and parabola, Correlation and Regression, Binomial distribution, Poisson distribution, Normal distribution.	

Text Books:

1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*

References:

1. *E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.*
2. *Veerarajan T., Engineering Mathematics for first year, McGraw-Hill, New Delhi, 2008.*
3. *R K. Jain & S R K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House 2002.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	Understand the concept of number system, Logic Gates, Boolean algebra, K-map and Quine Mclusky method	**L1 & L2**
CO-2	Design combinational and sequential logic circuits and their applications	**L4 & L6**
CO-3	Understand concepts of Synchronous & Asynchronous Sequential Circuits	**L1 & L2**
CO-4	Understand the idea of Digital Logic Families, memory and Programmable Logic Devices	**L1 & L2**
CO-5	Apply the concept of Digital Logic Families with circuit implementation.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Engineering Mathematics-III (RTAS-231)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	3	2	3	1	0	0	0	0	0	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	2
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech EE/EEE**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Network Analysis**
Course Code: RTEE-231	**Title: Network Analysis**

Course Objectives: The objectives of studying this course are,
1. Apply the knowledge of basic circuital law, nodal and mesh methods of circuit analysis and simplify the network using Graph Theory approach.
2. To learn network synthesis.

Nature of Paper: Core (Theory)

Minimum Passing Marks: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Node and mesh analysis, matrix approach of network containing voltage & current sources and reactances, source transformation and duality	**9L**
II	Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power transfer, compensation and Tallegen's theorem as applied to A.C. circuits.	**9L**
III	Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions. Steady state response of a network to non-sinusoidal periodic inputs, Power factor, effective values.	**9L**
IV	Network function for one-port and two-port, calculation of network function for ladder and general networks, poles and zeros with restrictions for driving point functions and transform functions. Two-Port Network: Introduction, Parameters, and Condition for reciprocity and symmetry, Relation between port parameters, Interconnection of two ports networks	**9L**
V	Sinusoidal response from pole-zero locations, convolution theorem, behaviour of series and parallel resonant circuits. Introduction to band pass, low pass, high pass and band reject filters.	**9L**

Text Books:
1. *Hayt and Kemmerly, "Engineering circuit analysis", McGraw Hill, 6th edition,2002.*
2. *T S KV IYER, "Theory and Problems in Circuit Analysis", Tata McGraw Hill, 2nd edition 1999.*
3. *M.S.Sukhija and T.K.Nagsarkar "Circuits and Networks", Oxford University Press, 3rd edition*

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References:

1. *Schaum series, "Circuit theory", McGrawHill, New Delhi, 4th edition, 2005.*
2. *Charles K Alex and and Mathew N. O Sadiku, "Fundamental of Electric Circuits", 2nd edition, TMH, New Delhi, 2003.*
3. *S.N. Sivanandam, "Electric Circuit Analysis", Vikas Publishing House Pvt. Ltd., New Delhi, 2008.*
4. *A. Sudhakar and S.P.Shyammohan "Circuits and Networks Analysis and Synthesis", TMH, 10th edition 2005*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12; Basic Electrical Engineering

Course Learning Outcomes:

CO-1	Facilitate electrical research and to introduce fundamental principles of circuit theory.	**L1& L2**
CO-2	Familiar in applying circuit theorems to simplify and find solutions to electrical circuits.	**L2 & L3**
CO-3	Course makes them to analyze three phase circuits.	**L2 & L3**
CO-4	Able to apply graph theory such as incidence matrix, reduced incidence matrix, tie set and cutset matrix.	**L2 & L3**
CO-5	Able to solve and analyze transient response of RL, RC and RLC circuits to DC and AC excitation.	**L2 &L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Network Analysis (RTEE-231)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	0	0	0	0	0	0	0	1
CO2	3	3	2	1	0	0	0	0	0	0	0	1
CO3	3	3	2	1	1	0	0	0	0	0	0	1
CO4	3	3	2	2	1	0	0	0	0	0	0	1
CO5	3	3	2	2	1	0	0	0	0	0	0	1

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech EE/EEE**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Electrical and Electronics Measurements and Instrumentation**
Course Code: RTEE-232	**Title: Electrical and Electronics Measurements and Instrumentation**

Course Objectives: The objectives of studying this course are,

1. To understand the basics of measurement and instrumentation and to acquire knowledge about calibration, and different types of electrical instruments.
2. Introduces the working principle of various bridges and magnetic measurements
3. Enable the students to identify and choose appropriate instruments for specific application.

Nature of Paper: Core (Theory)

Minimum Passing Marks: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Measurement system, Characteristics of instruments, Methods of measurement, Errors in Measurement & Measurement standards, Review of indicating and integrating instruments: Voltmeter, Ammeter and Wattmeter. Instrument transformer: Current and Potential transformer, ratio and phase angle errors.	9L
II	**Measurements:** Measurement of resistance-Low, Medium and High-AC Bridges-Maxwell's, Hay's, Anderson's, Desauty's bridge and Schering bridge for C and Wien's bridge for measurement of frequency. B-H curve and hysteresis loop using ballistic galvanometer, and Loss measurement using wattmeter method.	9L
III	**Electronic instruments:** Voltmeter, Multimeter, Wattmeter & energy meter. Time, Frequency and phase angle measurements using CRO; Storage oscilloscope, Spectrum & Wave analyzer, Digital counter, frequency meter, and Digital Voltmeter.	9L
IV	**Display and Recording Device:** LED & LCD Display Dot Matrix Display, 7 Segment Display Strip Chart Recorders Single point and multipoint Recorders–X-Y Recorders-Magnetic Tape Recorders-Data Loggers– Electromagnetic and Electrostatic interference.	9L
V	**Transducers:** Temperature transducers-RTD, thermistor, Thermocouple-Displacement transducer-Inductive, capacitive, LVDT, Pressure transducer–Bourdon tube, Bellows–Flow transducer–	9L

	Electromagnetic flow meter – Strain gauges– Piezoelectric and Hall effect transducer	

Text Books:

1. A.K. Sawhney,"A course of Electrical & Electronics measurements & instrumentation", Dhanpat Rai & sons, 2007.
2. Kalsi H.S, "Electronics Instrumentation, 2nd edition, TMH, 2004.
3. John P. Bentley, "*Principles of measurement system*", Addison Wesley Longman (Pvt.) Ltd., 2000

References:

1. G.S.Rangan, G.R.Sharmaand V.S.V.Mani, "*Instrumentation devices and systems*", Tata McGraw Hill, 2000.
2. James W. Dally, William F.Riley, Kennath G. McCornell, "*Instrumentation for engg. Measurements*", John Wiely & Sons (p) Ltd., 2003.
3. D.V.S. Moorthy, "*Transducers & Instrumentation*", Prentice Hall of India, 2008.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Basic Electrical Engineering

Course Learning Outcomes:

CO-1	Understand different measuring methods	**L2**
CO-2	Identify various types of errors	**L1 & L2**
CO-3	Learn the concept of display devices	**L2**
CO-4	Display the knowledge of transducers, their classifications and their applications	**L2 & L3**
CO-5	Display the knowledge of transducers, their classifications and their applications for the measurement of physical quantities like motion, force, pressure, temperature, flow and liquid level.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Electrical and Electronics Measurements and Instrumentation (RTEE-232)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	0	0	0	0	0	0	0	1
CO2	3	2	1	0	0	0	0	0	0	0	0	1
CO3	2	2	1	1	0	0	0	0	0	0	0	1
CO4	3	3	2	2	1	0	0	0	0	1	0	2
CO5	3	3	3	2	2	0	0	0	0	1	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech EE/EEE**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Digital Logic Design**
Course Code: RTEE-233	**Title: Digital Logic Design**

Course Objectives: The objectives of studying this course are,

1. To develop a strong foundation in analysis, design and implementation of digital electronic circuits
2. To present the Digital fundamentals, Boolean algebra and its applications in digital systems.
3. To familiarize with the design of various combinational digital circuits using logic gates.
4. To introduce the analysis and design procedures for synchronous and asynchronous sequential circuits.

Nature of Paper: Core (Theory)

Minimum Passing Marks: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Digital System and Binary Numbers**: Number System and its arithmetic, Signed binary numbers, Binary codes, Hamming Code, the map method up to five variable, Don't care conditions, POS simplification, NAND and NOR implementation, Quine Mc Clusky method (Tabular method).	9L
II	**Combinational Circuits:** Analysis & Design procedure, Binary Adder, Sub-tractor, n-bit parallel Adder & Sub-tractor, Magnitude Comparator, Multiplexers, De-multiplexers, Decoders, Encoders.	9L
III	**Sequential Logic:** Flip-flop and Latch, SR latch, JK flip-flop, T flip-flop, D flip-flop, Master-slave JK flip-flop, Flip Flop Conversion, Registers & Counters: Shift registers (SISO, SIPO, PISO, PIPO), Counters: Asynchronous/Ripple counters, Synchronous counters, Modulus-n Counter, Ring counter, Johnson counter, Up-Down counter.	9L
IV	**Digital Logic Families**: DTL, TTL, ECL & Metal Oxide Semiconductor logic families: N-MOS, P-MOS and CMOS logic circuits, Fan Out, Fan in, Noise Margin.	9L
V	**Memory & Programmable Logic Devices:** RAM, ROM, Programmable Logic Devices (PLDs): Basic concepts, PROM as PLD, Programmable Array Logic (PAL), Programmable Logic Array (PLA), Circuit Implementation using ROM, PLA and PAL.	9L

Text Books:
1. M. Morris Mano and M. D. Ciletti, "Digital Design", Pearson Education.
2. David J. Comer, "Digital Logic & State Machine Design", Oxford University Press.

References:
1. RP Jain, "Modern Digital Electronics", Tata McGraw Hill Publication.
2. Charles H Roth (Jr), Larry L. Kinney, "Fundamentals of Logic Design", Cengage Learning India Edition, 5th Edition, 2010.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Basic Electronics Engineering

Course Learning Outcomes:

CO-1	Understand and apply number systems, binary arithmetic, signed numbers, and error-detecting codes like Hamming Code.	**L2, L3**
CO-2	Simplify Boolean expressions using Karnaugh maps (up to 5 variables), Quine Mc Cluskey method, and implement combinational logic using NAND/NOR gates.	**L3, L4**
CO-3	Design and analyze combinational circuits such as adders, subtractors, multiplexers, decoders, encoders, and comparators.	**L3**
CO-4	Analyze and design sequential circuits using flip-flops, registers, and counters including up-down, ring, and Johnson counters.	**L4**
CO-5	Identify and compare various digital logic families and memory devices, and implement logic functions using ROM, PAL, and PLA.	**L2,L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Digital Logic Design (RTEE-233)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech EE/EEE**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Introduction to MATLAB**
Course Code: RSEE-231	**Title: Introduction to MATLAB**

Course Objectives: The objectives of studying this course are,

1. To compute all operations involving addition, multiplication, subtraction of matrices
2. To compute the inverse, trace, determinant of a matrix.ϖ
3. To plot figures
4. To develop user defined functions.
5. To know about fundamentals of MATLAB tool.
6. To provide an overview to program curve fitting & solve Linear and Nonlinear Equations
7. To understand the concept and importance of Fourier transforms.
8. To gain knowledge about MATLAB Simulink & solve Electrical engineering problems

Nature of Paper: SEC (Theory)

Minimum Passing Marks: 50% Marks / 2 Credits (30% of ESE & 40% of total)

L: 3	T: 0	P: 0	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Tutorial lessons 1:** Basic feature, A minimum MATLAB session, Starting MATLAB Using MATLAB As a calculator, Quitting MATLAB	3L
II	**Tutorial lessons 2** Getting started, Creating MATLAB variable, Over writing variable, Error message Making correction, Controlling the hierarchy of operations or precedence	3L
III	**Tutorial lessons 3:** Controlling the appearance of floating point number, Managing of Work Shop, Keeping track of your work session, Entering multiple statement per line Miscellaneous commands Getting help	3L
IV	**Tutorial lessons 4**: Exercises. Introduction, Mathematical function, Basic Plotting, Overview, Create Simple Point	3L
V	**Tutorial lessons 5**: Adding tittle, axis labels and annotations, Multiple data sets in one plot, Specifying line style and colors, Exercise, Introduction, Matrix Generation, Entering a vector,, Entering a matrix, Matrix Indexing, Colon operator, Linear spacing, Colon operator in a matrix.	3L

Text Books:
1. Agam Kumar Tyagi, "MATLAB and Simulink for Engineers", OXFORD Higher Education.
2. Dr. Shailendra Jain, "Modeling& Simulation using MATLAB – Simulink", Wiley – India.

Reference Books:
1. Won Y.Tang, Wemun Cao, Tae-Sang Ching and John Morris, "Applied Numerical Methods Using MATLAB", A John Wiley & Sons.
2. Steven T. Karris, "Introduction to Simulink with Engineering Applications", Orchard Publications

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	10
2) Presentations /Seminar	NA
3) Assignments	05
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	35
Total:	**50**

Prerequisites for the course: NA

Course Learning Outcomes:

CO-1	Able to implement loops, branching, control instruction and functions in MATLAB programming environment	**L2**
CO-2	Able to program curve fitting, numerical differentiation and integration, solution of linear equations in MATLAB	**L1, L2**
CO-3	Able to understand implementation of ODE using ode 45 and execute Solutions of nonlinear equations and DFT in MATLAB	**L2**
CO-4	Able to simulate MATLAB Simulink examples	**L6, L3**
CO-5	Able to analyse the results	**L5**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Introduction to MATLAB (RSEE-231)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	1	2	0	0	0	0	1	0	2
CO-2	3	2	2	1	2	0	0	0	0	1	0	2
CO-3	3	2	2	2	2	0	0	0	0	1	0	2
CO-4	2	2	3	2	3	0	0	0	0	2	1	2
CO-5	2	3	2	2	2	0	0	0	0	2	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech EE/EEE**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Network Analysis Lab**
Course Code: RTEE-231P	**Title: Network Analysis Lab**

Course Objectives: The objectives of studying this course are
1. Understand and gain knowledge about circuit laws and theorems.
2. Gain knowledge about time domain analysis of circuit transients.
3. Understand the concept of resonance in series and parallel circuits.
4. Learn how to use the PSpice software for simulating circuits.

Nature of Core (Lab)

Minimum Passing Marks: 50% Marks / 2 Credits (30% of ESE & 40% of total)

L: 0	T: 0	P: 2	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

No	Contents	No. of Lectures Allotted
1	Verification of principle of Superposition with AC sources.	2L
2	Verification of Thevenin theorem in AC Circuit.	2L
3	Verification of Maximum Power Transfer theorem in AC Circuit.	2L
4	Verification of Norton theorems in AC Circuit.	2L
5	Verification of Tellegen's theorem for two networks of the same topology.	2L
6	To verify Frequency Response of Series RLC Circuit.	2L
7	To verify Frequency Response of Parallel RLC Circuit.	2L
8	Determination of transient response of current in RL and RC circuits with step voltage input.	2L
9	Determination of transient response of current in RLC circuit with step voltage input for under damped, critically damped and over damped cases.	2L

Text Books:
1. Hayt and Kemmerly,"Engineering circuit analysis", Mc Graw Hill, 6th edition,2002.
2. Muhammed H Rashid, "SPICE for circuits and electronics using PSPICE", PHI, 2nd edition, 2011
3. M.S.Sukhija and T.K.Nagsarkar "Circuits and Networks", Oxford University Press, 3rd edition 2012

Reference Books:
1. Schaum series, "Circuit theory", McGrawHill, New Delhi, 4th edition, 2005.
2. Charles K Alex and and Mathew N. O Sadiku, "Fundamental of Electric Circuits", 2nd edition,

TMH, New Delhi, 2003.
3. S.N. Sivanandam, "Electric Circuit Analysis", Vikas Publishing House Pvt. Ltd., New Delhi, 2008.
4. *A. Sudhakar and S.P.Shyammohan "Circuits and Networks Analysis and Synthesis", TMH, 10th edition 2005.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Prerequisites for the course: Basic Electrical Engineering

Course Learning Outcomes:

CO-1	Apply the principle of superposition to analyze and verify circuit behavior when multiple AC sources are involved.	**L3**
CO-2	Demonstrate the ability to verify Thevenin's theorem in AC circuits for simplifying complex networks into equivalent circuits.	**L2, L4**
CO-3	Analyze and confirm the conditions for maximum power transfer in AC circuits through practical implementation of the theorem	**L4, L5**
CO-4	Implement and verify Norton's theorem to reduce complex AC circuits into simpler equivalent networks.	**L3, L5**
CO-5	Analyze the behavior of series and parallel RLC circuits by observing their frequency response and transient current behavior.	**L4,L5**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Network Analysis Lab (RTEE-231P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	1	2	0	0	0	0	1	0	2
CO-2	3	3	2	1	2	0	0	0	0	1	0	2
CO-3	3	3	2	2	2	0	0	0	0	1	0	2
CO-4	3	3	2	1	2	0	0	0	0	1	0	2
CO-5	3	3	2	2	2	0	0	0	0	1	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech EE/EEE**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Electrical and Electronics Measurement and Instrumentation Lab**
Course Code: RTEE-232P	**Title: Electrical and Electronics Measurement and Instrumentation Lab**

Course Objectives: The objectives of studying this course are,
1. Learn the measurement of non-electrical variables and electrical quantities using LABVIEW
2. Gain knowledge about the working of various Transducers
3. Simulate various controllers and stability analysis

Nature of Paper: Core (Theory)

Minimum Passing Marks: 50% Marks / 2 Credits (30% of ESE & 40% of total)

L: 0	T: 0	P: 2	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
1	Measurement of inductance using Maxwell's Bridge.	**2L**
2.	Calibration of AC voltmeter and AC ammeter.	**2L**
3.	Measurement of capacitance using Schering Bridge.	**2L**
4.	Measurement of low resistance using Kelvin's Double Bridge.	**2L**
5.	Extension of range and meters (voltmeter and ammeter).	**2L**
6.	Calibration of energy meters (single phase and three phase)	**2L**
7.	Measurement of inductance using Anderson's Bridge.	**2L**
8.	Measuring displacement using LVDT	**2L**
9.	Measuring temperature using thermocouple.	**2L**
10	PC based data logging of temperature sensor using LabVIEW/ MATLAB	**2L**

Text Books:
1. A.K. Sawhney, "A course of Electrical & Electronics measurements & instrumentation", Dhanpat Rai & sons, 2007.
2. Kalsi H.S, Electronics Instrumentation, 2nd edition, TMH, 2004.
3. John P. Bentley, "*Principles of measurement system*", Addison Wesley Longman (pvt.) Ltd., 2000

References:
1. G.S.Rangan, G.R.Sharmaand V.S.V. Mani, "*Instrumentation devices and systems*", Tata McGraw Hill, 2000.
2. James W. Dally, William F.Riley, Kennath G. McCornell, "*Instrumentation for engg.*

Measurements", John Wiely & Sons (p) Ltd., 2003.
3. D.V.S. Moorthy, "*Transducers & Instrumentation*", Prentice Hall of India, 2008

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Prerequisites for the course: Basic Electrical Engineering

Course Learning Outcomes:

CO-1	Identify different measuring instruments for the measurement of various electrical and non-electrical parameters.	**L1 & L2**
CO-2	Select various transducers for the measurement of physical quantities like temperature, pressure, distance and displacement.	**L2, L3**
CO-3	Compute the errors present in measuring instruments and calibrate them.	**L3, L5**
CO-4	Examine AC bridges for the measurement of inductance, capacitance and frequency.	**L5, L4**
CO-5	Analyze the characteristics of Solar panel, earth resistance and temperature transducers.	**L4,**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Electrical and Electronics Measurement and Instrumentation Lab (RTEE-232P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	1	1	1	0	0	0	0	1	0	1
CO-2	3	3	2	1	2	0	0	0	0	1	0	2
CO-3	3	3	2	2	2	1	0	0	0	1	0	2
CO-4	3	3	2	2	2	1	0	0	0	1	0	2
CO-5	3	3	2	2	2	0	1	1	0	1	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech EE/EEE**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Digital Logic Design Lab**
Course Code: RTEE-233P	**Title: Digital Logic Design Lab**

Course Objectives: The objectives of studying this course are

1. Students will be able to analyze and do some simple design of combinational logic.
2. Students will examine the various logic gates and circuits in the laboratory. They will design, build and troubleshoot logic circuits in the laboratory.
3. Students will be able to analyze and do some simple design of sequential logic. They will be familiar with and incorporate into circuits the latches, flip-flops, and counters.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (30% of ESE & 40% of total)

L: 0	T: 0	P: 2	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

No	Contents	No. of Lectures Allotted
1	Introduction to digital electronics lab- verification of the truth tables of logic gates.	**2L**
2	Design and implementation of Adder and Subtractor using logic gates.	**2L**
3	Design and implementation of 2 bit Magnitude Comparator using logic gates	**2L**
4	Design and implementation of Decoder using logic gates.	**2L**
5	Design and implementation of Encoder using logic gates	**2L**
6	Design and implementation of Multiplexer using logic gates.	**2L**
7	Design and implementation of De-multiplexer using logic gates.	**2L**
8	Verification of state tables of RS, JK, T and D flip-flops using NAND gates.	**2L**
9	Construction and verification of shift registers.	**2L**
10	Design, and verify the 4-bit synchronous counter.	**2L**

Text Books:

1. M. Morris Mano and M. D. Ciletti, “Digital Design”, Pearson Education.
2. David J. Comer, “Digital Logic & State Machine Design”, Oxford University Press

Reference Books:

1. RP Jain, “Modern Digital Electronics”, Tata McGraw Hill Publication.
2. Charles H Roth (Jr), Larry L. Kinney, “Fundamentals of Logic Design”, Cengage Learning India

Edition, 5th Edition, 2010		
If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**		
Evaluation/Assessment Methodology		
Category	**Internal/External**	**Max. Marks**
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**
Prerequisites for the course: Electronics Engineering		

Course Learning Outcomes:		
CO-1	Understand the Digital Binary System and implementation of Gates.	**L2 & L3**
CO-2	Understand and design combinational and sequential systems.	**L1 & L2**
CO-3	Design the counters with the help of sequential circuit and basic Gates.	**L3 & L4**
CO-4	Understand concepts of digital integrated circuits	**L1 & L2**
CO-5	Implement the projects using the digital ICs and electronics components.	**L3 & L5**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Digital Logic Design Lab (RTEE-233P)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	2	1	2	0	0	0	0	1	0	1
CO-2	3	3	2	1	1	0	0	0	0	1	0	1
CO-3	3	3	3	2	2	0	0	0	0	1	0	2
CO-4	3	2	2	1	1	0	0	0	0	1	0	1
CO-5	3	3	3	2	3	0	0	0	1	2	2	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech EE/EEE**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Integrated Communication Lab**
Course Code: RTAS-232P	**Title: Integrated Communication Lab**

Course Objectives: The objectives of studying this course are

1. To enhance students' English communication skills through structured practice in listening, speaking, reading, and writing activities relevant to academic and professional contexts.
2. To develop interpersonal and presentation skills required for group discussions, interviews, seminars, and workplace communication.
3. To build confidence in public speaking and professional interaction by encouraging active participation in role plays, debates, and extempore sessions.
4. To improve pronunciation, fluency, and vocabulary through language lab sessions and interactive modules.
5. To prepare students for industry and higher education opportunities by aligning communication training with real-world scenarios and corporate expectations.

Nature of Paper: AECC (Lab)

Minimum Passing Marks: 50% Marks / 2 Credits (30% of ESE & 40% of total)

L: 0	T: 0	P: 2	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

S.No.	Contents	No. of Lectures Allotted
1	Introduction to Integrated Communication Lab and activities for self-introduction and ice-breaking.	**2L**
2	Listening comprehension practice through audio clips and note-taking exercises.	**2L**
3	Role play and conversation practice for formal and informal situations.	**2L**
4	Group discussion and JAM (Just a Minute) session for fluency enhancement	**2L**
5	Reading comprehension and vocabulary-building exercises from short passages.	**2L**
6	Email and resume writing for academic and professional purposes.	**2L**
7	Report writing and paragraph writing on given topics.	**2L**
8	Mock interviews and feedback on spoken communication.	**2L**
9	Oral presentation on technical or general topics using PPT.	**2L**
10	Pronunciation, stress, and intonation practice through language lab software.	**2L**

Text Books:

1. Rizvi, M. Ashraf. (2005). Effective Technical Communication. New Delhi: Tata McGraw-Hill Education.
2. Kumar, Sanjay, & Lata, Pushp. (2018). Communication Skills. New Delhi: Oxford University Press.

Reference Books:

1. Meenakshi Raman & Sangeeta Sharma. (2015). Technical Communication: Principles and Practice (2nd ed.). New Delhi: Oxford University Press.
2. Goleman, Daniel. (1995). Emotional Intelligence: Why It Can Matter More Than IQ. New York: Bantam Books.
3. Carnegie, Dale. (1998). The Quick and Easy Way to Effective Speaking. New York: Pocket Books.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Prerequisites for the course: Electronics Engineering

Course Learning Outcomes:

CO1	Develop effective listening skills to comprehend and analyse spoken English in academic and professional settings.	**L2**
CO2	Demonstrate improved spoken English fluency, pronunciation, and confidence in group discussions, role plays, and interviews.	**L3**
CO3	Enhance reading comprehension skills to interpret and critically analyse a variety of texts and media.	**L2**
CO4	Acquire the ability to write structured and professional documents like emails, resumes, and short reports.	**L3**
CO5	Deliver formal presentations and interviews with clarity, organization, and effective verbal/non-verbal communication.	**L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Integrated Communication Lab (RTAS-232P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	1	1	0	0	1	0	0	1	2	3	1	1
CO-2	0	1	1	0	1	1	0	1	3	3	2	2
CO-3	1	1	0	0	1	0	0	1	2	2	1	1
CO-4	1	0	1	0	1	0	0	1	2	3	2	2
CO-5	0	0	1	0	2	0	0	1	3	3	2	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech EE/EEE**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Mathematics-III**
Course Code: RTAS-241	**Title: Mathematics-III**

Course Objectives: The objectives of studying this course are,
1. To make the students familiar with complex functions and its calculus.
2. To deal with applications, residues and conformal mapping.
3. To understand the concept and applications of integral transforms.
4. To deal with numerical solutions of algebraic equations and differential equations.
5. To understand the statistical aspect of functions.

Nature of Paper: Core (Theory)

Minimum Passing Marks: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Functions of a Complex Variable I**: Analytic functions; C-R equations and harmonic functions; Line integral in the complex plane; Cauchy's integral theorem, Cauchy's integral formula for derivatives of analytic functions; Liouvilles theorem.	9L
II	**Functions of a Complex Variable II**: Representation of a function by power series; Taylor's and Laurent's series; Singularities, zeroes and poles; Residue theorem, evaluation of real integrals; conformal mapping and bilinear transformations.	9L
III	**Integral Transforms:** Fourier integral, Fourier complex transform, Fourier sine and cosine transforms and applications to simple heat transfer equations. Z – Transform and its application to solve difference equations.	9L
IV	**Numerical Techniques:** Solution of polynomial and transcendental equations Bisection method, Regula – Falsi method, Newton - Raphson method. **Interpolation:** Finite difference, Newton's forward and backward interpolation, Lagrange's and Newton's divided difference formula for unequal intervals; **Numerical Differentiation**, **Numerical Integration**; Trapezoidal, Simpson's 1/3 and 3/8 rules. **Numerical solutions of first order differential equations** by Euler's method and 4th order Runge-Kutta method.	9L

V	**Statistical Techniques:** Moments, Moment generating functions, Skewness, Kurtosis, Curve Fitting and Solution of Equations: Method of least squares and curve fitting of straight line and parabola, Correlation and Regression, Binomial distribution, Poisson distribution, Normal distribution.	**9L**

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.
2. B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.
3. Dass H.K., Engineering Mathematics Vol-I, S. Chand.

References:

1. E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.
2. Veerarajan T., Engineering Mathematics for first year, McGraw-Hill, New Delhi, 2008.
3. R K. Jain & S R K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House 2002.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Engineering Mathematics-I & II

Course Learning Outcomes:

CO-1	Understand and check the Analyticity of a complex function.	**L2 & L4**
CO-2	To apply the concept of Analytic functions in residue and conformal mappings.	**L2 & L3**
CO-3	To solve and apply the concepts of transforms in the area of engineering.	**L3 & L5**
CO-4	To solve numerically the Algebraic equations, Differential equations, and to differentiate & integrate numerically.	**L2 & L3**
CO-5	To understand and use the concept of statistical tools to analyse the different data.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and Bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Mathematics-III (RTAS-241)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech EE/EEE**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Electrical Machine Engineering-1**
Course Code: RTEE-241	**Title: Electrical Machine Engineering-1**

Course Objectives:

1. To present a problem oriented introductory knowledge of Electrical Machines.
2. To focus on the study of electro mechanical energy conversion & different parts of electrical machine
3. To address the underlying concepts & methods behind Electrical Engineering machines.
4. To identify & formulate solutions to problems relevant to Electrical Machines and find the efficiency

Nature of Paper: Core (Theory)

Minimum Passing Marks: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**ELECTROMAGNETIC ENERGY CONVERSION:** Simple magnetic circuit calculations– B-H Relationship – Magnetically induced emf and force – AC operation of magnetic circuits – Hysteresis and Eddy current losses - Energy in magnetic system – Field energy and mechanical force – Energy conversion via electric field.	9L
II	**SINGLE-PHASE TRANSFORMER:** Principle-Construction – No load operation – Ideal Transformer- phasor diagram- no load and on load - Equivalent circuit – Parallel operation and load sharing of single-phase transformers – Testing – Losses — Efficiency, voltage regulation and all day efficiency, Applications.	9L
III	**AUTO TRANSFORMER:** Working principal, construction and saving in copper. **THREE PHASE TRANSFORMERS:** Principle-Construction-Polyphase connections – Star, Open-delta, Scott connection, three-phase to single phase conversion – On load tap changing – variable frequency transformer – Voltage and Current Transformers.	9L
IV	**DC GENERATOR:** Elementary concepts of rotating machines – MMF of distributed winding - DC Generator Construction – Lap and wave winding – emf equation- excitation, Communication Process and types of generators Characteristics - armature reaction-methods of improving commutation.	9L
V	**DC MOTOR:** Armature Reaction, torque equation – types-back emf and voltage equations-characteristics- Starting-Speed control- testing-direct,	9L

	indirect and regenerative tests-Power flow and efficiency- separation of losses-retardation test- Braking - DC machines dynamics – Applications, Maintenance Schedule of DC Machine.	

Text Books:

1. J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 5th Edition, 2017.
2. P. S. Bimbhra, "Electric Machinery", Khanna Publishers, 2nd Edition, 2021.

References:

1. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 6th Edition 2017.
2. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2018.
3. M. G. Say, "Performance and design of AC machines", CBS Publishers, First Edition 2008.
4. Sahdev S. K. "Electrical Machines", Cambridge University Press, 2018.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Basics of Electrical Engineering

Course Learning Outcomes:

CO-1	Understand and evaluate the performance of single phase and three phase transformers.	**L2 & L3**
CO-2	Understand the basic concepts of electromechanical energy conservation through energy and co-energy.	**L3 &L4**
CO-3	Ability to describe various methods to DC motor speed control.	**L1& L3**
CO-4	Ability to use applications based on the characteristics of machines.	**L2 & L3**
CO-5	Demonstrate and perform various connections of three phase transformers.	**L2& L4**
CO-6	Familiar in applying speed control in dc motors.	

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Electrical Machine Engineering-I (RTEE-241)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech EE/EEE**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Linear Integrated Circuit**
Course Code: RTEE-242	**Title: Linear Integrated Circuit**

Course Objectives: The objectives of studying this course are,

1. Learn the basics of op-amp, its characteristics, circuit model.
2. Discuss the performance and analyze the operation of several fundamentally important op-amp circuits that have certain features or characteristics oriented
3. Describe the basic operating principles of oscillator and discuss how different types of oscillators produce.
4. Describe the filter types, filter response characteristics, and analyze basic categories of active filters, which are low-pass, high-pass, band-pass, and band-stop.
5. Introduce data converter terminology and its performance parameters.

Nature of Paper: Core (Theory)

Minimum Passing Marks: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Op-amp symbol, terminals, packages and specifications, Block diagram Representation of op-amp- Ideal op-amp & practical op-amp - Open loop & closed loop configurations, Characteristics of op-amp	9L
II	Basic op-amp circuits: Inverting & Non-inverting voltage amplifiers, Voltage follower, Summing, Scaling & Averaging amplifiers, Linear Applications: Instrumentation Amplifiers, V-to-I and I-to-V converters, Differentiators and Integrators, Non-linear Applications: Precision Rectifiers, Wave Shaping Circuits (Clipper and Clampers), Analog voltage multiplier circuit and its applications, Comparators and its applications, Sample and Hold circuit.	9L
III	Waveform Generators: Sine-wave Generators- RC Phase Shift Oscillator, Wien Bridge Oscillator, Square/ Triangle Wave generators. IC 555 Timer: Monostable operation and its applications, Astable operation	9L
IV	Filters: Comparison between Passive and Active Networks, Active Network Design , Filter Approximations, Design of 1^{st}& 2^{nd} order LPF, HPF, BPF and Band Reject Filters	9L
V	Digital to Analog Conversion: DAC Specifications, Weighted Resistor DAC, R-2R Ladder DAC and Inverted R-2R Ladder DAC, Analog to	9L

	Digital conversion: ADC specifications, Ramp Type ADC, Successive Approximation ADC, Dual Slope ADC, Flash Type ADC.	

Text Books:
1. M. Morris Mano and M. D. Ciletti, "Digital Design", Pearson Education.
2. David J. Comer, "Digital Logic & State Machine Design", Oxford University Press.

References:
1. RP Jain, "Modern Digital Electronics", Tata McGraw Hill Publication.
2. Charles H Roth (Jr), Larry L. Kinney, "Fundamentals of Logic Design", Cengage Learning India Edition, 5th Edition, 2010.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Basics of Electronics

Course Learning Outcomes:

CO-1	This is a course on the design and applications of operational amplifiers and analog integrated circuits	**L1, &L2**
CO-2	This course introduces basic op-amp principles and show how the opamp can be used to solve a variety of application problems.	**L2 & L3**
CO-3	Much attention is given to basic op-amp configurations, linear and non-linear applications of op-amp and active filter synthesis	**L2 & L3**
CO-4	It also deals with oscillators, waveform generators and data converters	**L2 & L3**
CO-5	Students will gain knowledge about the working principle of data converters along with application specific ICs such as 555 timer and PLL.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Linear Integrated Circuit (RTEE-242)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech EEE/EE**	**Year: II** **Semester: IV**
Credits: 2 **Theory: 2** **Practical: 0**	**Subject: Indian Ethos and Modern Management**
Course Code: IEMM-402	**Title: Indian Ethos and Modern Management**

Course Objectives:

1. To introduce the concept of Indian ethos and its relevance in modern managerial practices.
2. To understand and apply the philosophical insights of Chanakya in personal and professional success.
3. To explore management principles from Indian scriptures like the Mahabharata, Ramayana, Geeta, and Vedas.
4. To examine traditional Indian systems of learning and their contribution to karma, self-management, and corporate behavior.
5. To promote ethics- and value-based management practices in a globalized, culturally diverse workplace.

Nature of Paper: VAC (Theory)

Minimum Passing Marks: 40% Marks / 2 Credits (30% of ESE & 40% of total)

L: 3	**T:** 0	**P:** 0	**C:** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Indian Ethos:** Meaning, Features, Need, History, Relevance, Principles Practiced by Indian Companies, Requisites, Elements, Role of Indian Ethos in Managerial Practices, Indian Heritage in Business Management, Ethics v/s Ethos, Indian Vs Western Management.	9L
II	**Chankaya's Philosophy-A Way to Personal and Public Victory and Management:** Application and Impact of Chanakya's Philosophy in Personal life, Achieving success in professional life with Chankaya, Corporate Chanakya.	9L
III	**Management Lessons from Indian Scriptures-I:** Management Lessons from Mahabharata, Management lessons from Geeta, Management Lessons from Ramayana	9L
IV	**Management Lessons from Indian Scriptures-II**: anagement Lessons from the Vedas, Management Lessons from the Bible, and Management Lessons from the Quran	9L
V	**Indian Systems of Learning:** Modern System of Learning: Meaning, Features, Advantages, Disadvantages. Karma: Meaning, Importance of Karma to Managers, Nishkama Karma. Laws of Karma: The Great Law,	9L

	Law of Creation, Law of Humility, Law of Growth, Law of Responsibility, Law of Connection. Corporate Karma: Meaning, Methodology, Guidelines for Good Corporate Karma. Self-management: Personal Growth and Lessons from Ancient Indian Education System	
VI	Relevance of Value-based& Ethics Based Management in Global Change Developing Code of Culture in Organization, Ethical, and Value-Based Leadership, the impact of Values on stakeholders; Trans-cultural human values; Secular - Vs Spiritual values; value system in work culture.	**9L**

Textbooks :-

1. Gaur, R. R., Sangal, R., & Bagaria, G. P. (2010). *A Foundation Course in Human Values and Professional Ethics*. New Delhi: Excel Books.
2. Gupta, R. (2011). *Indian Ethos and Values in Management*. New Delhi: Tata McGraw Hill Education.

Reference Books

1. Pillai, R. (2010). *Corporate Chanakya*. Mumbai: Jaico Publishing House.
2. Nair, R. R. (2013). *Ethics in Management: Insights from Ancient Indian Wisdom*. New Delhi: Ane Books.
3. Sharma, S. K. (2014). *Management and Business Ethics*. New Delhi: I.K. International Publishing House.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Explain the meaning, principles, and significance of Indian ethos in comparison with Western management practices.	**L2**
CO-2	Apply Chanakya's philosophy and teachings to achieve effectiveness in personal conduct and managerial functions.	**L3**
CO-3	Interpret and extract relevant management lessons from Indian scriptures such as the Mahabharata, Geeta, Ramayana, and Vedas.	**L4**
CO-4	Demonstrate understanding of karma-based leadership, self-management, and ancient Indian educational values in organizational settings.	**L3**
CO-5	Analyze the impact of value-based and ethics-driven leadership in managing organizational culture and stakeholder relationships	**L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Indian Ethos and Modern Management (IEMM-402)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	2	–	–	–	–	3	–	3	–	2	–	2
CO-2	–	1	2	–	–	3	–	3	2	2	2	2
CO-3	–	2	–	–	–	2	–	3	1	2	–	2
CO-4	–	–	–	–	–	3	–	3	2	2	–	2
CO-5	–	1	–	–	–	3	2	3	2	2	2	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech EE/EEE**	**Year: II** **Semester: IV**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Electrical Machines Engineering-1 Lab**
Course Code: RTEE-241P	**Title: Electrical Machines Engineering-1 Lab**

Course Objectives: The students will learn
To expose the students to the operation of D.C. machines and transformers and give them experimental skill.

Nature of Paper: Core (Lab)

Minimum Passing Marks: 50% Marks / 2 Credits (30% of ESE & 40% of total)

L: 0	T: 0	P: 2	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

No	Contents	No. of Lectures Allotted
1	To study Load test on DC shunt and series Motors.	**2L**
2	To study Open Circuit Characteristics and load test on self-excited DC shunt Generator	**2L**
3	To study Open Circuit Characteristics and load test on separately excited DC shunt Generator	**2L**
4	To study Load test on DC series Generator	**2L**
5	To study Load test on single phase transformer	**2L**
6	To study O.C and S.C test on single phase transformer	**2L**
7	To study Magnetizing Characteristics of DC Shunt generator	**2L**
8	To study Scott Connection of single-phase transformers	**2L**
9	To verify Sumpner's test on single phase transformers	**2L**
10	Study of three phase transformer connections	**2L**
11	To study Speed Torque Characteristics of DC Shunt Motor	**2L**

Text Books:
1. M. Morris Mano and M. D. Ciletti, "Digital Design", Pearson Education.
2. David J. Comer, "Digital Logic & State Machine Design", Oxford University Press.

Reference Books:
1. RP Jain, "Modern Digital Electronics", Tata McGraw Hill Publication.
2. Charles H Roth (Jr), Larry L. Kinney, "Fundamentals of Logic Design", Cengage Learning India Edition, 5th Edition, 2010.

If the course is available as **Generic Elective**, then the students of following departments may opt it:
NO

Evaluation/Assessment Methodology		
Category		**Max. Marks**
Category	**Internal/External**	**Max. Marks**
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Prerequisites for the course: Electric Machine

Course Learning Outcomes:

CO-1	Understand the concept of differentiability and apply in the study of Successive differentiation, Leibnitz theorems and Partial differentiation.	**L2 & L3**
CO-2	Identify the application of partial differentiation and apply for evaluating maxima, minima, series and Jacobians.	**L3 &L4**
CO-3	Remember the concept of matrices and apply for solving linear simultaneous equations.	**L1& L3**
CO-4	Illustrate the working methods of multiple integral and apply for finding area, volume.	**L2 & L3**
CO-5	Remember the concept of vector and apply for directional derivatives, tangent and normal planes. Also evaluate line, surface and volume integrals.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Electrical Machines Engineering-1 Lab (RTEE-241)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech EE/EEE**	**Year: II** **Semester: IV**
Credits: NC **Theory:** **Practical:**	**Subject: Linear Integrated Circuit Lab**
Course Code: RTEE-242P	**Title: Linear Integrated Circuit Lab**

Course Objectives: The students will learn
1. To understand the basics of linear integrated circuits and available ICs
2. To understand the characteristics of the operational amplifier.
3. To apply operational amplifiers in linear and nonlinear applications.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: NC

L: 0	T: 0	P: 3	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

No	Contents	No. of Lectures Allotted
1	To study Load test on DC shunt and series Motors.	2L
2	To study Open Circuit Characteristics and load test on self-excited DC shunt Generator	2L
3	To study Open Circuit Characteristics and load test on separately excited DC shunt Generator	2L
4	To study Load test on DC series Generator	2L
5	To study Load test on single phase transformer	2L
6	To study O.C and S.C test on single phase transformer	2L
7	To study Magnetizing Characteristics of DC Shunt generator	2L
8	To study Scott Connection of single-phase transformers	2L
9	To verify Sumpner's test on single phase transformers	2L
10	Study of three phase transformer connections	2L
11	To study Speed Torque Characteristics of DC Shunt Motor	2L

Text Books:
1. M. Morris Mano and M. D. Ciletti, "Digital Design", Pearson Education.
2. David J. Comer, "Digital Logic & State Machine Design", Oxford University Press.

Reference Books:
1. RP Jain, "Modern Digital Electronics", Tata McGraw Hill Publication.
2. Charles H Roth (Jr), Larry L. Kinney, "Fundamentals of Logic Design", Cengage Learning India Edition, 5th Edition, 2010.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Prerequisites for the course: Basics of Electronics

Course Learning Outcomes:

CO-1	Understand the concept of differentiability and apply in the study of Successive differentiation, Leibnitz theorems and Partial differentiation.	**L2 & L3**
CO-2	Identify the application of partial differentiation and apply for evaluating maxima, minima, series and Jacobians.	**L3 & L4**
CO-3	Remember the concept of matrices and apply for solving linear simultaneous equations.	**L1 & L3**
CO-4	Illustrate the working methods of multiple integral and apply for finding area, volume.	**L2 & L3**
CO-5	Remember the concept of vector and apply for directional derivatives, tangent and normal planes. Also evaluate line, surface and volume integrals.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Linear Integrated Circuit Lab (RTEE-242P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech EE/EEE**	**Year: II** **Semester: IV**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Analog Electronics Lab**
Course Code: RTEE-243P	**Title: Analog Electronics Lab**

Course Objectives: The students will learn
1. To understand the basics of linear integrated circuits and available ICs
2. To understand the characteristics of the operational amplifier.
3. To apply operational amplifiers in linear and nonlinear applications.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (30% of ESE & 40% of total)

L: 0	T: 0	P: 2	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

No	Contents	No. of Lectures Allotted
1	To Plot V-I characteristics of P-N junction diode and Zener diode.	2L
2	To draw wave shape of the electrical signal at input and output points of the half wave, full wave and bridge rectifiers.	2L
3	To Plot input / output characteristics for common base transistor.	2L
4	To determine voltage gain, current gain, input impedance and output impedance and frequency response of R-C coupled common emitter amplifier.	2L
5	To Plot input /output characteristics of FET and determine FET parameters at a given operating point.	2L
6	To Plot input /output characteristics of MOSFET and determine MOSFET parameters at a given operating point.	2L
7	To study transistor as a switch and determine load voltage and load current when the transistor is ON.	2L
8	Measurement of Operational Amplifier Parameters: Common Mode Gain, Differential Mode Gain, CMRR, Slew Rate.	2L
9	Applications of Op-amp: Op-amp as summing amplifier, Difference amplifier, Integrator and differentiator.	2L
10	Study of Instrumentation Amplifier.	2L
11	To plot V-I characteristics of SCR.	2L
12.	To plot V-I characteristics of TRIAC.	2L

Text Books:

1. M. Morris Mano and M. D. Ciletti, "Digital Design", Pearson Education.
2. David J. Comer, "Digital Logic & State Machine Design", Oxford University Press.

Reference Books:

1. RP Jain, "Modern Digital Electronics", Tata McGraw Hill Publication.
2. Charles H Roth (Jr), Larry L. Kinney, "Fundamentals of Logic Design", Cengage Learning India Edition, 5th Edition, 2010.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category		**Max. Marks**
Category	**Internal/External**	**Max. Marks**
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Prerequisites for the course: Basics of Electronics

Course Learning Outcomes:

CO-1	Understand the concept of differentiability and apply in the study of Successive differentiation, Leibnitz theorems and Partial differentiation.	**L2 & L3**
CO-2	Identify the application of partial differentiation and apply for evaluating maxima, minima, series and Jacobians.	**L3 &L4**
CO-3	Remember the concept of matrices and apply for solving linear simultaneous equations.	**L1 & L3**
CO-4	Illustrate the working methods of multiple integral and apply for finding area, volume.	**L2 & L3**
CO-5	Remember the concept of vector and apply for directional derivatives, tangent and normal planes. Also evaluate line, surface and volume integrals.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Analog Electronics Lab (RTEE-243)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech EE/EEE**	**Year: II** **Semester: IV**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject:**
Course Code: SPT-PC-111	**Title: Sports**

Course Objectives: The objectives of studying this course are
1. To develop students' physical fitness, mental well-being, and proficiency in various individual and team sports through structured participation and practice.
2. To foster qualities of discipline, teamwork, sportsmanship, and strategic thinking by engaging students in competitive and recreational games and physical activities.

Nature of Paper: Core (Lab)

Minimum Passing Marks: 50% Marks / 2 Credits (30% of ESE & 40% of total)

L: 0	T: 0	P: 2	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

No	Contents	No. of Lectures Allotted
1	Archery/ Athletics/ Badminton/ Basketball/ Boxing/ Carrom/ Chess/ Cricket/ Football/ Handbal/l Judo/ Kabaddi/ Kho-Kho/ Martial Arts/ Powerlifting/ Table/ Tennis/ Volleyball/ Weightlifting/ Wrestling/ Yoga.	2L

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	15
2) Presentation/Seminar/Viva-Voce(Internal)		-
3) External Practical Assessment	External Assessment	35
4) Presentation/Seminar/Viva-Voce(External)		-
5) Practical Records		-
Total:		**50**

Prerequisites for the course: NA

Course Learning Outcomes:

CO-1	Demonstrate basic skills, rules, and techniques required for effective participation in individual sports such as athletics, archery, boxing, and martial arts.	**L3**
CO-2	Exhibit proficiency in team-based sports like football, basketball, volleyball, kabaddi, and kho-kho, with emphasis on coordination, communication, and team strategy	**L3, L4**
CO-3	Analyze and apply rules, scoring systems, and tactics in indoor games such as chess, carrom, and table tennis to enhance cognitive and decision-making skills.	**L4**

CO-4	Develop and maintain physical fitness, flexibility, and endurance through regular practice and participation in strength-based and aerobic activities such as yoga, powerlifting, and athletics	**L3**
CO-5	Demonstrate sportsmanship, ethical behavior, self-discipline, and leadership qualities both during practice and competitive events.	**L3,L5**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Sports (SPT-PC-111)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	2	1	2	1	1	–	–	–	2	1	–	2
CO-2	–	1	2	–	–	–	–	–	3	2	2	2
CO-3	1	2	–	–	1	–	–	2	2	2	–	2
CO-4	–	–	–	2	–	–	2	–	1	1	–	3
CO-5	–	–	–	–	–	3	–	3	3	2	3	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV
Department Specific Electives-I (Offered to B.Tech IVth Semester)

Program: UG(R) **Class: B.Tech EE/EEE**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Sustainable Energy**
Course Code: RDEE-241	**Title: Sustainable Energy**

Course Objectives: The objectives of studying this course are,

1. To understand the different types of non-conventional energy resources like solar, wind, biomass, ocean, tidal and wave sources and their conversion techniques.

Nature of Paper: DSE (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**SOLAR ENERGY:** Various solar energy systems and their applications, Solar spectra-latitude and longitude, Declination angle, solar window, cosine law, seasonal variations, daily variation, hour angle, Calculation of angle of incidence, Principle of photovoltaic conversion of solar energy - Types of solar cells and fabrication, Photovoltaic - battery charger, domestic lighting, street lighting, water pumping etc. Solar Photovoltaic power plant – Net metering concept.	9L
II	**WIND ENERGY:** Nature of the wind – wind power– factors influencing wind, Wind data and energy estimation - wind speed monitoring - wind resource assessment - Betz limit - site selection, Types of wind turbines – Various control-Tip Speed Ratio – Solidity, Torque on wind-wind thrust calculations	9L
III	**BIO-ENERGY:** Energy from Biomass - Biomass as Renewable Energy Source - Types of Biomass Fuels - Solid, Liquid and Gas, Biomass Conversion Techniques- Wet Process, Dry Process-Photosynthesis - Biogas Generation, Factors affecting Bio-digestion –Different digesters – Digesters sizing - Advantages and Disadvantages, Energy Forming – Pyrolysis	9L
IV	**ENERGY FROM OCEANS:** Ocean Thermal Energy Conversion (OTEC): Principle- Lambert Law of absorption - Open and closed OTEC Cycles - Major problems and operational experience, Tidal energy: Tide – Spring tide, Neap tide – Tidal range – Tidal Power – Types of Tidal power plant, Single and dual basin schemes- Requirements in tidal power	9L

	plant, Wave Energy – Wave Characteristics,	
V	**GEOTHERMAL ENERGY:** Geothermal Energy – Classification, Fundamentals of geophysics, Dry rock and hot aquifers energy analysis, Estimation of thermal power , Extraction techniques	**9L**

Text Books:

1. Rai , G.D., "Non-Conventional sources of Energy", Khanna Publishers, 5th Edition 2016.
2. Rai , G.D., "Non-Conventional sources of Energy", Khanna Publishers, 5th Edition 2016.

References:

1. Rao. S. & Pamlekar Dr. B.B. "Energy Technology ", Khanna Publishers, 3rd Edition 2016.
2. John W Twidell and Tony D Weir, "Renewable Energy Resources", Taylor and Francis, 2nd Edition 2006.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: NA

Course Learning Outcomes:

CO-1	Understand the concept of various non-conventional energy resources	**L1, L2**
CO-2	Acquire in-depth knowledge on the conversion of non-conventional energy resources into Electrical power	**L1, L2**
CO-3	Become intellectual in new developments of renewable energy studies	**L2**
CO-4	Attain knowledge in green energy technologies	**L1, L2**
CO-5	Understand the various applications and uses of renewable sourses	

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Sustainable Energy (RDEE-241)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech EE/EEE**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Electromagnetic Field Theory**
Course Code: RDEE-242	**Title: Electromagnetic Field Theory**

Course Objectives: The objectives of studying this course are,

1. To understand the concept of coordinate systems, It's Cartesian, Cylindrical & spherical transformation.
2. To understand electrostatic & magnetic fields and their parameters.
3. To understand waves & its applications.

Nature of Paper: DSE (Theory)

Minimum Passing Marks: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Coordinate Systems and Transformation**: Basics of Vectors: Addition, subtraction and multiplications; Cartesian, Cylindrical, Spherical transformation. Vector calculus: Differential length, area and volume, line surface and volume integrals, Del operator, Gradient, Divergence of a vector, Divergence theorem, Curl of a vector, Stokes's theorem, Laplacian of a scalar.	9L
II	**Electrostatic fields**: Coulombs law and field intensity, Electric field due to charge distribution, Electric flux density, Gausses' Law- Maxwell's equation, Electric dipole and flux line, Electric field in material space: Properties of materials, convection and conduction currents, conductors, polarization in dielectrics, Dielectric-constants, boundary conditions, Electrostatic boundary value problems: Poisson's and Laplace's equations., Methods of Images.	9L
III	**Magneto statics** : Magneto-static fields, Biot - Savart's Law, Ampere's circuit law, Maxwell's equation, Application of ampere's law, Magnetic flux density- Maxwell's equation, Maxwell's equation for static fields, magnetic scalar and vector potential.	9L
IV	**Coordinate Systems and Transformation**: Basics of Vectors: Addition, subtraction and multiplications; Cartesian, Cylindrical, Spherical transformation. Vector calculus: Differential length, area and volume, line surface and volume integrals, Del operator, Gradient, Divergence of a vector, Divergence theorem, Curl of a vector, Stokes's theorem, Laplacian of a scalar.	9L

V	**Waves and Applications**: Maxwell's equation, Faraday's Law, Wave propagation in loss dielectrics, Plane waves in lossless dielectrics Plane wave in free space. Plain waves in good conductors, Power and the pointing vector, Reflection of a plain wave in a normal incidence. Transmission Lines and Smith Chart.	**9L**

Text Books:

1. MNO Sadiku, "Elements of Electromagnetic', Oxford University Press. B.L. Theraja, "*Electrical* **References:** Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010.
2. WH Hayt and JA Buck, "Engineering Electromagnetic", McGraw- Hill Education.

Reference Books:

1. G.S.N.Raju., "Electromagnetic Field Theory and Transmission Lines", Pearson Education, First Indian print, 2006
2. Nannapaneni Narayana Rao, "Principles of Engineering Electromagnetics", Pearson Education, Sixth Edition, 2016

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Physics of Class 12

Course Learning Outcomes:

CO-1	Apply different coordinate systems and their application in electromagnetic field theory, establish a relation between any two systems	**L2, L3**
CO-2	Understand the concept of static electric field. Understand the concept of current and properties of conductors. Establish boundary conditions	**L1, L2**
CO-3	Understand the concept of static magnetic field, magnetic scalar and vector potential Ability to describe various methods to control speed.	**L1, L2**
CO-4	Understand the forces due to magnetic field, magnetization, magnetic boundary conditions and inductors.	**L1, L2**
CO-5	Understand displacement current, time varying fields, propagation and reflection of EM waves and transmission lines.	**L1, L2**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Electromagnetic Field Theory (RDEE-242)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2

CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech EE/EEE**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Smart Sensor Systems**
Course Code: RDEE-243	**Title: Smart Sensor Systems**

Course Objectives: The objectives of studying this course are,
1. To learn the various sensors used to measure various physical parameters.
2. To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

Nature of Paper: DSE (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Classification of Transducers, Advantages and Disadvantages of Electrical Transducers, Transducers Actuating Mechanisms, Resistance Transducers, Variable Inductance Transducers, Capacitive Transducers, Piezoelectric Transducers, Hall Effect Transducers, Thermoelectric Transducers, Photoelectric Transducers.	**9L**
II	**Electromechanical and Magnetic Sensors:** Stain Gages, Load Cells, Proximity Sensors, Pneumatic Sensors, Light Sensors, Tactile Sensors, Fiber Optic Transducers, Digital Transducers, Recent Trends – Smart Pressure Transmitters, Selection of Sensors, Rotary – Variable Differential Transformer, Synchros and Resolvers, Induction Potentiometers, Micro Electromechanical Systems. Wiedemann effect for yoke coil sensors, Thomson effect, Hall effect, and Hall drive, performance characteristics.	**9L**
III	**SPECIAL SENSORS**: GPS, Bluetooth, Smart Sensors – Film sensor, MEMS & Nano Sensors, LASER sensors. Touch screen sensor, Heading Sensors – Compass, Gyroscope, Inclinometers, Applications of sensors in drone. **DISPLAY DEVICES & SYSTEMS:** Classification of displays- Storage CRTs, Flat CRTs, LEDs, LCD display, Gas discharge plasma displays, Incandescent display, Electrophoretic image displays(EPID), Liquid Vapor Display (LVD)	**9L**
IV	**SIGNAL CONDITIONING:** Introduction, Functions of Signal Conditioning Equipment, Amplification, Types of Amplifiers, Mechanical Amplifiers Fluid Amplifiers, Optical Amplifiers, Electrical and electronic Amplifiers. Applications of Attenuators, Passive filters in	**9L**

	signal conditioning, Op-amp based signal conditioning circuits	
V	**DATA ACQUISITION SYSTEMS AND CONVERSION:** Introduction, Objectives and Configuration of Data Acquisition System, Data Conversion. **Data Transmission and Telemetry:** Data/Signal Transmission, Telemetry. Measurement of Non – Electrical Quantities: Pressure Measurement	**9L**

Text Books:

1. Ernest O Doebelin, "Measurement Systems – Applications and Design", Tata McGraw-Hill, 2009. David J. Comer, "Digital Logic & State Machine Design", Oxford University Press.
2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th edition, Dhanpat Rai and Co, New Delhi, 2013.

References:

1. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	Expertise in various calibration techniques and signal types for sensors.	**L1**
CO-2	Apply the various sensors in the Automotive and Mechatronics applications	**L2**
CO-3	Study the basic principles of various smart sensors.	**L1, L2**
CO-4	Implement the data acquisition systems with different sensors for real time applications	**L2, L3**
CO-5	Locate different type of sensors used in real life applications and paraphrase their importance	**L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Smart Sensor Systems (RDEE-243)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech EE/EEE**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Electronics Devices & Circuits**
Course Code: RDEE-244	**Title: Electronics Devices & Circuits**

Course Objectives: The objectives of studying this course are,
1. To introduce components such as diodes, BJTs and FETs.
2. To know the applications of components.
3. To know the switching characteristics of components.
4. To give understanding of various types of amplifier circuits.

Nature of Paper: DSE (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Diode and Applications:** Diode - Static and Dynamic resistances, Equivalent circuit, Load line analysis, Diffusion and Transition Capacitances, Diode Applications: Switch-Switching times. Rectifier - Half Wave Rectifier, Full Wave Rectifier, Bridge Rectifier, Rectifiers with Capacitive and Inductive Filters, Clippers-Clipping at two independent levels, Clamper-Clamping Circuit Theorem, Clamping Operation, Types of Clampers.	9L
II	**Bipolar Junction Transistor (BJT):** Principle of Operation, Common Emitter, Common Base and Common Collector Configurations, Transistor as a switch, switching times, Transistor Biasing and Stabilization - Operating point, DC & AC load lines, Biasing - Fixed Bias, Self Bias, Bias Stability, Bias Compensation using Diodes.	9L
III	**Junction Field Effect Transistor (FET):** Construction, Principle of Operation, Pinch Off Voltage, Volt-Ampere Characteristic, Comparison of BJT and FET, Biasing of FET, FET as Voltage Variable Resistor. Special Purpose Devices: Zener Diode - Characteristics, Voltage Regulator. Principle of Operation - SCR, Tunnel diode, UJT, Varactor Diode.	9L
IV	**Analysis and Design of Small Signal Low Frequency BJT Amplifiers:** Transistor Hybrid model, Determination of h-parameters from transistor characteristics, Typical values of h- parameters in CE, CB and CC configurations, Transistor amplifying action, Analysis of CE, CC, CB Amplifiers and CE Amplifier with emitter resistance, low frequency	9L

	response of BJT Amplifiers, effect of coupling and bypass capacitors on CE Amplifier.	
V	**FET Amplifiers:** Small Signal Model, Analysis of JFET Amplifiers, Analysis of CS, CD, CG JFET Amplifiers. MOSFET Characteristics in Enhancement and Depletion mode, Basic Concepts of MOS Amplifiers.	**9L**

Text Books:

1. Electronic Devices and Circuits- Jacob Millman, McGraw Hill Education.
2. Electronic Devices and Circuits theory– Robert L. Boylestead, Louis Nashelsky, 11th Edition, 2009, Pearson.

References:

1. The Art of Electronics, Horowitz, 3rd Edition Cambridge University Press
2. Electronic Devices and Circuits, David A. Bell – 5th Edition, Oxford.
3. Pulse, Digital and Switching Waveforms –J. Millman, H. Taub and Mothiki S. Prakash Rao, 2nd Ed., 2008, Mc Graw Hill.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	Know the characteristics of various components.	**L1**
CO-2	Understand the utilization of components.	**L3**
CO-3	Understand the biasing techniques.	**L1, L2**
CO-4	Design small signal amplifier circuits.	**L2**
CO-5	Analyze small signal amplifier circuits.	**L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Electronics Devices & Circuits (RDEE-241)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Control Systems**
Course Code: SEEE-351	**Title: Control Systems**

Course Objectives: The objectives of studying this course are,

1. To understand the basic components of control systems and gain knowledge in time and frequency domain tools for the design and analysis of feedback control systems.
2. To employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions and identify the needs of different types of controllers and compensator to ascertain the required dynamic response from the system.
3. Formulate different types of analysis in frequency domain to explain the nature of stability of the

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3 T: 1 P: 0 (in Hours/Week) Theory - 1 Hr. = 1 Credit Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Classical control theory concepts; Mathematical modeling of physical systems, transfer function approach; concept of poles and zeros, Open and closed loop control systems; Simplification of complex systems using block diagram reduction technique and Mason's gain formula (signal flow graphs).	09
II	**Time Response Analysis:** Standard test signals; Transient analysis of first and second order systems using standard test signals; correlation between pole location in s-plane and time-response; time-response analysis specification, Steady state analysis, Error criteria and its importance.	09
III	**Root locus:** concepts, construction of root loci, root contours. **Frequency response analysis:** Introduction and its importance; correlation between frequency response and time-response analysis; frequency response specifications, Frequency response plots, Polar plot and Bode plot.	09
IV	**Stability Analysis:** Concept of stability of LTI systems, Routh and Hurwitz Stability criteria; relative stability analysis using Routh's stability criterion, Stability analysis in frequency domain, Nyquist stability criterion; Relative stability analysis using phase margin and gain margin specifications.	09

V	**State Space Analysis:** Introduction to state-variable, advantages of state variable approach over transfer function–derivation of transfer function from state space model- Solution to state equation–homogenous system–state transition matrix and its properties–Introduction to controllability and observability concepts.	09

If the course is available as Generic Elective then the students of following departments may opt it.

Evaluation/Assessment Methodology

Max. Marks	
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics, Signal & Systems, Physics

Course Learning Outcomes: After undergoing this course, the students will be able to:

CO1. Categorize different types of system and identify a set of algebraic equations to represent and model a complicated system into a more simplified form.
CO2. Understand the concept of LTI control systems, Importance of feedback in control systems and stability concept.
CO3. Employ time domain analysis to predict and diagnose transient performance parameters of the system for standard input functions.
CO4. Formulate different types of analysis in frequency domain to explain the nature of stability of the system.
CO5. Analyze the stability of the closed and open loop systems. CO6. Develop and analyze state space models.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Electrical Machines-II**
Course Code: SEEE-352	**Title: Electrical Machines-II**

Course Objectives: The objectives of studying this course are,
1. Comprehend the construction, principle of operation, characteristics of three phase induction motor and their application.
2. Know the construction and performance of synchronous machines.

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (in Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Induction Machine-I:** Construction and application of single-phase induction motor, AC windings, Establishment of magnetic poles, Rotating magnetic field; Three phase induction motor: Construction, types and operation, Torque equation, Condition for Maximum Torque, Mechanical characteristics effect of supply voltage and rotor resistance on torque, No load & blocked rotor tests, efficiency- derivation of exact equivalent circuit.	09
II	**Induction Machine-II:** Torque-Power and torque-slip relationship, Performance characteristics/calculations, Starting methods, braking-Cogging and crawling, Speed control methods and influence on speed-torque curve, Double cage rotor, Induction generator, Synchronous induction Motor.	09
III	**Synchronous Generator:** Types, construction and principle of operation-emf equation- winding factor , effect of chording and winding distribution – armature reaction – Voltage regulation by synchronous impedance, MMF and Poitier triangle methods - load characteristics – Parallel operation of synchronous generators, Synchronizing to infinite bus-bars-power transfer equations, capability curve- two reaction model of salient pole synchronous machines and power angle characteristics - determination of Xd & Xq by slip test- Short circuit transients in synchronous machines.	09

IV	**Synchronous Motor:** Principle of operation, methods of starting, power flow, power developed by Synchronous motor, phasor diagrams – torque angle characteristics, effects of varying load and varying excitation, excitation and power circles for synchronous machine – 'V' and inverted 'V' curves – hunting – Synchronous phase modifier – Induction motor Vs Synchronous motor.	09
V	**Special Machine:** Construction, Principle of operation and applications of Reluctance motor, Two phase Servo motor, Stepper motors, Universal motor, linear induction motor, Permanent magnet DC motor, Hysteresis Motor, Repulsion motor and AC series Motor.	09

If the course is available as Generic Elective then the students of following departments may opt it. **Not applicable**

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics, Physics

Course Learning Outcomes: After undergoing this course, the students will be able to:

CO1. Understand the operating principle and characteristics of 3-phase induction motor.
CO2. Describe different tests for calculating the performance parameters of three phase induction motors.
CO3. Explain the fundamental control practices like starting, reversing and speed control strategies for different applications.
CO4. Analyse working principal and performance characteristics of synchronous machines.
CO5. Understand working principal, characteristics and applications of special machines.
CO6. Explain the basic concepts of Synchronous Machines, construction, EMF equation and armature reaction.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Elements of Power Systems**
Course Code: SEEE-353	**Title: Elements of Power Systems**

Course Objectives: The objectives of studying this course are,

1. Recognize elements of power system and their functions, as well as compare the different types of supply systems.
2. Illustrate different types of conductors, transmission lines and various performance parameters of transmission line for short, medium and long transmission line.

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (in Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Power Generation:** Basic structure of power system, conventional and nonconventional sources; Load curve, load duration curve, Concept of Connected Load, Maximum Demand, Average load, Demand Factor, Load factor, Diversity Factor, Capacity Factor, Utilization factor, Plant use factor, installed capacity, Reserves, role of load diversity in power system economy.	09
II	**Configuration of Transmission lines:** Single line diagram of Power system, choice of transmission voltage, Different kinds of supply system and their comparison; Types of conductors, Bundled Conductors, resistance of line, skin effect, Kelvin's law, Proximity effect; Corona Effect, factors affecting the Corona, Corona Power Loss, Advantages and Disadvantages; Representation of lines, short transmission lines, medium length lines, nominal T and л-representations, long transmission lines, Ferranti Effect.	09
III	**Mechanical Design of Overhead Lines**: Catenary curve, calculation of sag & tension, effects of wind and ice loading, sag template, vibration dampers; **Insulators:** Overhead line Insulators, Type of insulators and their applications, potential distribution over a string of insulators, methods of equalizing the potential, string efficiency.	09
IV	**Line Parameters:** Inductance and Capacitance Calculations of Transmission Lines: Line conductors, inductance and capacitance of single phase and three phase lines with symmetrical, Composite conductors- transposition.	09

V	**Insulated cables:** Introduction, insulation, insulating materials, Extra high voltage cables, grading of cables, insulation resistance of a cable, Capacitance of a single core and three core cables, Overhead lines versus underground cables, types of cables	09

If the course is available as Generic Elective then the students of following departments may opt it.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics, Physics

Course Learning Outcomes: After undergoing this course, the students will be able to:

CO1. Describe the working principle and basic components of conventional power plants as well as the other aspects of power generation.

CO2. Recognize elements of power system and their functions, as well as compare the different types of supply systems.

CO3. Compute the inductance and capacitance of single phase, three phase lines with symmetrical and unsymmetrical spacing.

CO4. Understand Composite conductors-transposition, bundled conductors, and understand the effect of earth on capacitance of transmission lines.

CO5. Develop the ability to implement the appropriate safety equipment for design of electrical power system.

CO6. Enhancing the efficiency of the transmission and distribution system with environment friendly technology.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Signals and Systems**
Course Code: SDEE-351	**Title: Signals and Systems**

Course Objectives: The objectives of studying this course are,

1. To impart knowledge of fundamentals of signals and systems, and to mathematically analyze different types of signals and their associated systems.
2. Trains students for an intermediate level of fluency with signals and systems in both continuous time and discrete time.

Nature of Paper: DSE

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (in Hours/Week)
Theory - 1 Hr. = 1 Credit Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Continuous Time Signals and Systems**: Introduction to continuous time and discrete time signals, Classification of signals with their mathematical representation and characteristics. Transformation of independent variable, Introduction to various type of system, basic system properties. **Analogous System**: Linear& Rotational mechanical elements, force-voltage and force-current analogy, modeling of mechanical and electro-mechanical systems: Analysis of first and second order linear systems by classical method.	09
II	**Analysis of Continuous Time Signals:** Fourier Transform Analysis: Exponential form and Compact trigonometric form of Fourier series, Fourier symmetry, Fourier transform: Properties, application to network analysis. Definition of DTFS, and DTFT, Sampling Theorem.	09
III	**LTI CT System:** Laplace Transform Analysis: Review of Laplace Transform, Properties of Laplace Transform, Initial & Final value Theorems, Inverse Laplace Transform, Convolution Theorem, Impulse response, Application of Laplace Transform to analysis of networks, waveform synthesis and Laplace Transform to complex waveforms	09
IV	**State – Variable analysis:** State – Variable analysis: Introduction, State Space representation of linear systems, Transfer function and state Variables, State Transition Matrix, Solution of state equations for homogeneous and non-homogeneous systems, Applications of State – Variable technique to the analysis of linear systems.	09

V	**Z – Transform:** Z – Transform Analysis: Concept of Z – Transform& ROC, Z – Transform of common functions, Inverse Z – Transform, Initial& Final value Theorems, Applications to solution of difference equations, Properties of Z-transform**.**	09

If the course is available as Generic Elective then the students of following departments may opt it.
Not applicable

Evaluation/Assessment Methodology

Max. Marks	
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics, Physics

Course Learning Outcomes:
After undergoing this course, the students will be able to:

CO1. Acquire knowledge of various classifications of Signals and Systems.
CO2. Utilize the mathematical computing tool for analysis of signals and systems.
CO3. Analyze Periodic and Aperiodic Continuous time Signals using Fourier series.
CO4. Analyze and characterize the Continuous time system through Laplace transform and Fourier transform.
CO5. Analyze and characterize the Discrete time system through Z transform.
Classify systems based on their properties and determine the response of LTI system using convolution.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Sustainable Energy**
Course Code: SDEE-352	**Title: Sustainable Energy**
Course Objectives: The objectives of studying this course are, 1. To understand the different types of non-conventional energy resources like solar, wind, biomass, ocean, tidal and wave sources and their conversion techniques.	
Nature of Paper: DSE	
Minimum Passing Marks/Credits: 40% Marks / 4 Credits	
L: 3 T: 1 P: 0 (in Hours/Week) Theory - 1 Hr. = 1 Credit Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)	

Unit	Contents	No. of Lectures Allotted
I	**SOLAR ENERGY:** Various solar energy systems and their applications, Solar spectra-latitude and longitude, Declination angle, solar window, cosine law, seasonal variations, daily variation, hour angle, Calculation of angle of incidence, Principle of photovoltaic conversion of solarenergy - Types of solar cells and fabrication, Photovoltaic - battery charger, domestic lighting, street lighting, water pumping etc, Solar Photovoltaic power plant – Net metering concept.	09
II	**WIND ENERGY:** Nature of the wind – wind power– factors influencing wind, Wind data and energy estimation - wind speed monitoring - wind resource assessment - Betz limit - site selection, Types of wind turbines – Various control-Tip Speed Ratio – Solidity, Torque on wind-wind thrust calculations.	09
III	**BIO-ENERGY:** Energy from Biomass - Biomass as Renewable Energy Source-Types of Biomass Fuels - Solid, Liquid and Gas, Biomass Conversion Techniques- Wet Process, Dry Process-Photosynthesis - Biogas Generation, Factors affecting Bio-digestion –Different digesters – Digesters sizing - Advantages and Disadvantages, Energy Forming – Pyrolysis.	09
IV	**ENERGY FROM OCEANS:** Ocean Thermal Energy Conversion (OTEC): Principle- Lambert Law of absorption - Open and closed OTEC Cycles-.Major problems and operational experience, Tidal energy: Tide – Spring. tide, Neap tide – Tidal range – Tidal Power – Types of Tidal power plant, Single and dual basin schemes- Requirements in tidal power	09

	plant, Wave Energy – Wave Characteristics,	
V	**GEOTHERMAL ENERGY:** Geothermal Energy – Classification, Fundamentals of geophysics, Dry rock and hot aquifers energy analysis, Estimation of thermal power, Extraction techniques	09

If the course is available as Generic Elective then the students of following departments may opt it.

Evaluation/Assessment Methodology

Max. Marks	
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes: After undergoing this course, the students will be able to:

CO1. Understand the concept of various non-conventional energy resources.
CO2. Acquire in-depth knowledge on the conversion of non-conventional energy resources into Electrical power.
CO3. Become intellectual in new developments of renewable energy studies.
CO4. Attain knowledge in green energy technologies.
CO5. Understand the various applications and uses of renewable sources.
CO6. Examine various Electric Energy Conversion Systems.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: HVDC & AC Transmission**
Course Code: SDEE-353	**Title: HVDC & AC Transmission**

Course Objectives: The objectives of studying this course are,
1. To acquire knowledge in basic principles, economic aspects and calculations involved in EHVAC and HVDC System.
2. To familiarize the students with the HVDC converters and their control system.
3. To expose the students to the harmonics and faults occur in the system and their prevention.

Nature of Paper: DSE

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (in Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**EHV transmission-I:** standard transmission voltage, comparison of EHV AC & DC transmission systems and their applications & limitations, surface voltage gradients in conductor, distribution of voltage gradients on sub- conductors, mechanical considerations of transmission lines, modern trends in EHV AC and DC transmission.	09
II	**EHV Transmission-II:** Corona loss formulas, corona current, audible noise – generation and characteristics corona pulses their generation and properties, radio interference (RI) effects, over voltage due to switching, ferro-resonance, reduction of switching surges on EHV system.	09
III	**Extra High Voltage Testing:** Characteristics and generation of impulse voltage, generation of high AC and DC voltages, measurement of high voltage by sphere gaps and potential dividers. Consideration for Design of EHV Lines: Design factors under steady state limits, EHV line insulation design based upon transient over voltages.	09
IV	**HVDC Transmission–I:** Types of dc links, converter station, choice of converter configuration and pulse number, effect of source inductance on operation of converters, working principle and characteristics of a 6 pulse converter with two & three valve conduction mode, three valve conduction mode and three and four valve conduction mode, Principle of DC link control.	09

V	**EHV DC Transmission–II:** Converter faults, protection against over currents and over voltages, smoothing reactors, generation of harmonics, AC and DC filters, Multi Terminal DC systems (MTDC): Types, control, protection and applications.	09

If the course is available as Generic Elective then the students of following departments may opt it.
Not applicable

Evaluation/Assessment Methodology

Max. Marks	
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO1. Trace the comparison of EHVAC and HVDC transmission while understanding various issues related to transmission.
CO2. Calculate and study the corona loss and its impacts. Cite examples of the causes of switching overvoltage, Ferro-resonance.
CO3. Explain the generation and measurement circuits for impulse, high DC & AC voltages.
CO4. Analyze various types of converters and their working.
CO5. Study and understand the control scheme of HVDC converters.
CO6. Discuss firing angle control of 6 pulse, 12 pulse circuits.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Power System Stability**
Course Code: SDEE-354	**Title: Power System Stability**

Course Objectives: The objectives of studying this course are,
1. To acquire knowledge on the fundamental concepts of stability of power systems and its classification.
2. To expose the students to dynamic behavior of the power system for small and large disturbances.

Nature of Paper: DSE

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (in Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Definition, Causes, Nature and Effects of disturbances, Classification of stability, Modeling of electrical components - Basic assumptions made in stability studies-Modeling of Synchronous machine for stability studies (classical model) - Rotor dynamics and the swing equation.	09
II	**SMALL-SIGNAL STABILITY:** Basic concepts and definitions – State space representation, Physical Interpretation of small–signal stability, Eigen properties of the state matrix: Eigenvalues and eigenvectors, modal matrices, eigenvalue and stability, mode shape and participation factor.	09
III	**TRANSIENT STABILITY:** Review of numerical integration methods: modified Euler and Fourth Order Runge-Kutta methods, Interfacing of Synchronous machine (classical machine) model to the transient stability algorithm (TSA).	09
IV	**VOLTAGE STABILITY:** Factors affecting voltage stability-Classification of Voltage stability-Transmission system characteristics-Generator characteristics- Load characteristics- Characteristics of reactive power compensating Devices.	09
V	**ENHANCEMENT OF SMALL-SIGNAL STABILITY AND TRANSIENT STABILITY:** Power System Stabilizer – Principle behind transient stability enhancement methods: high-speed fault clearing, regulated shunt compensation, dynamic braking, reactor switching.	09

If the course is available as Generic Elective then the students of following departments may opt it. **Not applicable**	
Evaluation/Assessment Methodology	
	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**
Prerequisites for the course: Power System Analysis, Mathematics	
Course Learning Outcomes: After undergoing this course, the students will be able to:	
CO1. To attains knowledge about the stability of power system. CO2. Learners will have knowledge on small-signal stability, transient stability and voltage stability. CO3. To understand the dynamic behaviour of synchronous generator for different disturbances. CO4. Understand Voltage stability problem and preventive methods for voltage collapse. CO5. To understand the various methods to enhance the stability of a power system.	

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: V**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Control Systems Lab**
Course Code: SEEE-351P	**Title: Control Systems Lab**

Course Objectives: The objectives of studying this course are,

1. Understand and be able to use the laboratory techniques, tools, and practices of control engineering.
2. Be able to specify components, implement a control system, test and debug it, and appropriately report the results of a control design project.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 2 Credits

L: 0
T: 0
P: 3(in Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

	Contents
Practical-1	To determine response of second order systems for step input.
Practical-2	To determine response of second order systems for square input.
Practical-3	To study P, PI and PID temperature controller for an oven and compare their
Practical-4	To study and calibrate temperature using resistance temperature detector (RTD)
Practical-5	To study DC position control system
Practical-6	To study synchro-transmitter and receiver and obtain output vs input characteristics
Practical-7	To determine speed-torque characteristics of an ac servomotor.
Practical-8	To study behavior of separately excited dc motor in open loop and closed loop conditions at various loads.
Practical-9	To simulate PID controller for transportation lag

If the course is available as Generic Elective then the students of following departments may opt it.
Not applicable

Evaluation/Assessment Methodology

Max. Marks	
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	30
Total:	**50**

Prerequisites for the course: Mathematics, Signal & Systems, Physics
Course Learning Outcomes: After undergoing this course, the students will be able to:
CO1. Compare the performance of control systems by applying different controllers. CO2. Apply different stability methods of time domain in control systems & examine their stability. CO3. Evaluate possible causes of discrepancy in practical experimental observations in

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: V**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Electrical Machine-II Lab**
Course Code: SEEE-352P	**Title: Electrical Machine-II Lab**
Course Objectives: The objectives of studying this course are, To provide the practical exposure to the student regarding construction and operation of various electrical machines like Alternators, Synchronous motors, Induction Motors.	
Nature of Paper: Core	
Minimum Passing Marks/Credits: 50% Marks / 2 Credits	
L: 0 T: 0 P: 3 (in Hours/Week) Theory - 1 Hr. = 1 Credit Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)	

Practical	Contents
Practical-1	Study Load test on 3-phase squirrel cage Induction Motor
Practical-2	To perform No load & Blocked rotor test on 3-phase squirrel cage Induction Motor (Performance determination using equivalent circuit and circle diagram)
Practical-3	Study Load test on 1 phase Induction Motor
Practical-4	Study of speed control of Induction Motor
Practical-5	To perform OC and SC test on 3-phase Alternator
Practical-6	Study Synchronization of 3-phase Alternator with bus bars
Practical-7	To determine Xd and Xq 3-Phase Alternator.
Practical-8	To plot Study V-Curve of 3-Phase Alternator.
Practical-9	To plot Study inverted V-Curve of 3-Phase Alternator.
Practical-10	Brake Test On 3- ϕ Squirrel Cage Induction Motor
Practical-11	Equivalent circuit of a single-phase induction motor

If the course is available as Generic Elective then the students of following departments may opt it.
Not applicable

Evaluation/Assessment Methodology	
Max. Marks	
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	30
Total:	**50**

Prerequisites for the course: Mathematics, Physics
Course Learning Outcomes: After undergoing this course, the students will be able to:
CO1. To understand the Load test setup for Induction motor (Induction machine). CO2. Demonstrate the working of three phase synchronous machine under different operating conditions. CO3. Evaluate possible causes of discrepancy in practical experimental observations in comparison to theory by introducing the concepts of different stability theorems.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: V**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Power Systems Lab**
Course Code: SEEE-353P	**Title: Power Systems Lab**

Course Objectives: The objectives of studying this course are,
1. To develop computer programs for analysis of power systems.
2. To analyze the performance of power system networks by conducting various experiments.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 2 Credits

L:0
T:0
P:3 (In Hours/Week)
Theory – 0 Practical- 3

	Contents
Practical-1	Calculate the parameters of single-phase transmission line
Practical-2	Determine the ABCD constant for transmission line.
Practical-3	Simulate the Ferranti effect in transmission line
Practical-4	To determine fault current in single Line to Ground fault
Practical-5	To determine fault current in Line to Line fault
Practical-6	To study IDMT over current Relay.
Practical-7	To study instantaneous over current Relay.
Practical-8	To study over Voltage Relay.
Practical-9	To determine breakdown strength of Transformer Oil.

If the course is available as Generic Elective then the students of following departments may opt it.
Not applicable

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	30
Total:	**50**

Prerequisites for the course: Mathematics, Physics

Course Learning Outcomes: After undergoing this course, the students will be able to:

CO1. To understand the various Test on relays for different characteristics and compare with the performance characteristics provided by manufacturers.
CO2. Analyze various types of short circuit faults.
CO3. To understand the performance of different relays.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Power Electronics**
Course Code: SEEE-361	**Title: Power Electronics**

Course Objectives: The objectives of studying this course are,

- Introduce the different power electronics circuits, like AC/DC, DC/DC and DC/AC converters, in power processing applications.
- The major power switching devices used in power electronics applications will be the preliminary objective.
- Operation and performance evaluation of AC/DC power conversion circuit using controlled rectifiers will be discussed for different types of loads.
- Use of these circuits in various applications will be discussed.

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (in Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures
I	**Introduction**: Power switching devices overview: ideal & real switching characteristics -power diode, BJT, SCR, TRIAC, MOSFET, GTO, IGBT-V-I characteristics, turn- on, turn-off methods; protection- di/dt,dv/dt, over current, overvoltage; specifications, losses, thermal characteristics, series and parallel operation, triggering circuits.	09
II	**Rectifiers:** Operation and analysis of single and three phase rectifiers – half and fully controlled Converters, converter and inverter operation – waveforms, gate time control, output voltage, input current, power factor, effect of load and source inductances. Series converter, dual converter – four-quadrant operation with and without circulating current.	09
III	**Chopper**: Principles of high-power chopper circuits – class A, B, C, D and E chopper, voltage commutated, current commutated chopper, principle of operation of buck, boost and buck boost regulators; time ratio control, variable frequency control, duty cycle.	09
IV	**Inverters**: Principles of high power VSI and CSI inverters, Modified McMurray, auto sequential inverter–waveforms at load and commutating elements; inverters: analysis of three phase inverter circuits with star and delta loads.	09

V	**AC voltage controller**: Principle of single phase – ON/OFF and phase angle control **Cyclo converters**: Principle of single-phase cyclo converters circuits, input and output performances- different control techniques and firing pulse generation. Applications – regulated power supply, UPS.	09

If the course is available as Generic Elective then the students of following departments may opt it.
Not applicable

Evaluation/Assessment Methodology

Max. Marks	
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report	-
5) Seminar On Research Project Report	-
6) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes: After undergoing this course, the students will be able to:

CO1: Understand the operating concepts of SCR, BJT, TRIAC etc
CO2: Understand the applications of rectifiers, choppers, inverters
CO3: Comprehend the non-isolated DC-DC converters and apply their use in different Power electronics applications.
CO4: Understand the principal of different types of inverters
CO5: Apprehend the working of single-phase ac voltage controllers, cyclo-converters and their various applications.
CO6: Apprehend the different control techniques and firing pulse generation.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Microprocessor & Microcontroller**
Course Code: SEEE-362	**Title: Microprocessor & Microcontroller**

Course Objectives: The objectives of studying this course are,

1. Introduce the generalized concepts of functional blocks namely registers, ALU, timing and control, interfacing of the microprocessor unit
2. Introduces the concept of interfacing memory and I/O devices and data transfer techniques.
3. Functions and operations of the microprocessors and microcontrollers and develop assembly code using different addressing modes for various applications.

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (in Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Microprocessor Architecture:** 8085 Microprocessor architecture– Registers, Arithmetic and logic section, Timing and Control section and Interface section-Machine Cycles and bus timings. Program structure & programming techniques for microprocessors, 8085 Addressing modes.	09
II	**8085 Programming and Interrupts:** 8085 Instruction set, Assembly language programming of 8085 microprocessor with examples (arithmetic operations on 8-bit numbers – add, subtract, multiply, divide, square & square root etc, largest / smallest number; ascending / descending order). 8085 Interrupt structure-vectored interrupts	09
III	**Memory I/O Interface:** Memory Interfacing, Programmable Peripheral device(8255), Timer/ Counter (8253), Programmable keyboard display interfaces (8279) - Programmable interrupt controller (8259) - USART (8259)	09
IV	Intel 8086 microprocessor: Internal architecture (Bus Interface Unit, Execution unit, Pipelining, Register organization), Pin Diagram, Memory addressing, Physical memory organization, Interrupts (hardware & software interrupts)	09

V	**Microcontroller:** Introduction to Microcontrollers– 8051– Architecture – programming -hardware -Input/ Output ports and circuits-Memory -Counter and Timers- Serial net Input/ Output-Interrupts-interfacing keyboard, LCD, ADC and DAC.	09

If the course is available as Generic Elective then the students of following departments may opt it.
Not applicable

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Outcomes: After studying the above course the student will be able to,
CO1: Understand the various sections/blocks of microprocessor.
CO2: Able to implement the programming concepts through designing programme.
CO3: Understand the concept of interfacing & Interfacing/Peripheral devices
CO4: Compare accepted standards and guidelines to select appropriate Microprocessor (8085 & 8086) and Microcontroller to meet specified performance requirements
CO5: Understand the working of microcontroller.
CO6: Understand the working of various peripheral like-Counter and Timers- Serial net Input/Output-Interrupts-interfacing keyboard, LCD, ADC and DAC.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Power System Analysis**
Course Code: SDEE-361	**Subject: Power System Analysis**
Course Objectives: The objectives of studying this course are, • Perform power flow analysis using numerical techniques and Analyze the behavior of the power system under faulted condition.	
Nature of Paper: DSE	
Minimum Passing Marks/Credits: 40% Marks / 4 Credits	
L: 3 T: 1 P: 0 (in Hours/Week) Theory - 1 Hr. = 1 Credit Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)	

Unit	Contents	No. of Lectures
I	**Review of symmetrical components**: Transformation matrices used in resolution of unbalanced voltages and currents-Positive, Negative and Zero sequence networks of power system components-Sequence networks of impedance loads. Symmetrical Faults and asymmetrical Faults: Derivation of fault current for LG, LL, LLG.	09
II	**Load Flow**: Introduction, Formation of YBUS, Formulation of load flow equations-Solution of simple problems by considering voltage-controlled buses, tap changing transformers, phase shift control, Effect due to new lines, loads and voltages- Gauss, Gauss- Seidel method for calculating line voltages and real and reactive powers.	09
III	**Power System Protection:** Operating Principle and Classifications of Relays according to time and applications. Overcurrent Relay, Distance Protection, Differential Protection, Circuit Breakers: Arc Extinction Theories, Restriking Voltage & Recovery Voltage, Types and Selection of Circuit Breaker. Alternator Protection, transformer Protection, Transmission Line Protection	09
IV	**Power System Stability**: Power flow through a transmission line, Stability and Stability limit, Steady state stability study, derivation of Swing equation, transient stability studies by equal area criterion. Factors affecting steady state and transient stability and methods of improvement.	09

V	**Travelling Waves on Transmission Lines**: Production of traveling waves, open circuited line, short circuited line, line terminated through a resistance, line connected to a cable, reflection and refraction at T-junction line terminated through a capacitance, capacitor connection at a T-junction, Attenuation of travelling waves.	09

If the course is available as Generic Elective then the students of following departments may opt it.
Not applicable

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Outcomes: After studying the above course the student will be able to,

CO1: Understand the configuration of different transmission lines. Also illustrate various performance parameters and types of conductors in Transmission line.
CO2: Understand and interpret the results of load flow analysis in an electrical power network.
CO3: Understand the basics of power system protection and different types of relays and circuit breakers.
CO4: Understand the dynamics and stability of power systems.
CO5: Analyse and compute the performance of transmission lines in various conditions
CO6: Analyse the performance of traveling waves and Attenuation of travelling waves.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Modern Control Systems**
Course Code: SDEE-362	**Title: Modern Control Systems**

Course Objectives: The objectives of studying this course are,

- To understand the basic concepts of modern control theory in relation to the stability of a system.
- To co relate the concepts of control theory with the field of electrical engineering

Nature of Paper: DSE

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (in Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures
I	**Introduction to Classical Design:** Introduction to compensating networks – lead, lag, lead-lag compensation – feedback compensation – P, PI, PID controllers– design using Bode plot and root locus techniques.	09
II	**State Space Analysis:** State space formulation–state variable–phase variables and canonical variables–state model From differential equation–state transition matrix– state space representation of discrete time systems	09
III	**State Space Design:** Eigen values and Eigen vectors – Diagonalization–canonical forms - Controllability and observability–Controller design by state feedback– Necessary and sufficient condition for arbitrary pole placement – tate regulator problem. Observer Design– Fullorder/reduced order observer design.	09
IV	**Stability:** Stability concepts–BIBO Asymptotic Stability-stability definitions in state space domain–Stability theorems on local and global stability–Lyapunov stability analysis- Krasovskii Method.	09
V	**Optimal Control:** Linear quadratic optimal regulator (LQR) problem formulation–optimal regulator design by parameter adjustment (Lyapunov method) – optimal regulator design by Continuous - time Algebraic Riccatti Equation (CARE)– optimal controller design using LQG framework.	09

If the course is available as Generic Elective then the students of following departments may opt it.
Not applicable

Evaluation/Assessment Methodology

Max. Marks

1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Outcomes: After studying the above course the student will be able to,

CO1: Understand classical controller synthesis techniques like PI control, lead-lag compensation and state space analysis of linear dynamic systems.
CO2: Understand the Modeling and analysis of systems in the state space domain will be dealt with in detail.
CO3: Design controllers using state-feedback control approach.
CO4: Understand the concept of stability in control systems.
CO5: Analyse and synthesize controllers for linear systems in a state-space framework.
CO6: Understand the concept of stability definitions in state space domain and optimal regulator design by parameter adjustment.

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: FACTS Controller**
Course Code: SDEE-363	**Title: FACTS Controller**

Course Objectives: The objectives of studying this course are,
1. To learn the concept of power flow control through various power electronic controllers including state of art FACTS controllers.
2. Operational aspects and their capabilities and their integration in power flow analysis.
3. FACTS controllers and to learn the effectiveness of FACTS controllers in distribution system for harmonic mitigation etc.

Nature of Paper: DSE

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (in Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures
I	**Compensators:** Introduction to FACTS controllers– Reactive power control-Reactive power, uncompensated Transmission line, reactive power compensation– Principles of conventional reactive power compensators-Synchronous condensers, saturated reactor, phase angle regulator and other controllers.	09
II	**Thyristor Controlled Shunt Compensator:** Objective of shunt compensation–Principle and operating characteristics of Thyristor Controlled Reactor (TCR)–Thyristor Switched Capacitor (TSC)– Static VAR Compensators (SVC)–SVC control system–SVC voltage regulator model–Transfer function and dynamic performance of SVC–Transient stability enhancement.	09
III	**Thyristor Controlled Series Compensator:** Series compensation–Principles of operation of TCSC–Capability characteristics of TCSC–Modeling of TCSC–TCSC control system– enhancement of system damping-mitigation of sub synchronous resonance.	09
IV	**VSC Based Shunt and Series Compensator:** Static Synchronous Compensator (STATCOM)-Principle of operation- VI Characteristics Harmonic performance – Steady state model– SSR mitigation-Static Synchronous Series Compensator(SSSC)-Principle of operation and characteristics of SSSC–control range and VA rating– capability to provide real power compensation–Immunity to sub-synchronous resonance.	09

V	**Unified Power Flow Controller:** Basic operating principles–conventional transmission control capability of UPFC– Independent Real and reactive power flow control– control scheme for UPFC– Basic control system for P and Q control – dynamic performance	09

If the course is available as Generic Elective then the students of following departments may opt it.
Not applicable

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Outcomes: After studying the above course the student will be able to,
CO1: Understand concepts of FACTS controller.
CO2: Understand the concept of TCR, TCS, SVC, STATCOM.
CO3: Analyse the Modeling of TCSC and enhancement of system damping.
CO4: To understand operation principal of various compensators.
CO5: To understand basics of unified power flow controller.
CO6: To understand operating principles of conventional transmission control capability of UPFC.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VO

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Electrical Machine Design**
Course Code: SDEE-364	**Title: Electrical Machine Design**
Course Objectives: The objectives of studying this course are, 1. To impart the knowledge on the concepts of design of different types of electrical machines.	
Nature of Paper: DSE	
Minimum Passing Marks/Credits: 40% Marks / 4 Credits	
L: 3 T: 1 P: 0 (in Hours/Week) Theory - 1 Hr. = 1 Credit Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)	

Unit	Contents	No. of Lectures Allotted
I	Fundamentals of Design Rating and dimensions – Temperature rise – heating and cooling curves – rating of electric machines - insulation requirements – insulation materials -MMF for air-gap - Net iron length – MMF for Iron - MMF for teeth – Real and Apparent flux densities - Leakage flux	09
II	Design of DC Machines Magnetic circuit calculations-Output equation-Main Dimensions-Choice of specific electric and magnetic loadings-Selection Of Number of Poles- Armature design–Design of shunt field coil– Design of commutator and brushes.	09
III	Design of Transformers Output Equations of Single-phase and three phase transformer–Main Dimensions- KVA output for single and three phase transformers–Window space factor–Overall Dimensions–Determination of number of turns and length of mean turns of windings-Resistance of windings- No load current calculation.	09
IV	Design of Three Phase Induction motor Output Equation of Induction motor–Main dimensions–Length of air gap- Design of squirrel cage rotor-Rules for selecting rotor slots of squirrel cage machines–Design of rotor bars & slots– Design of end rings–Design of wound rotor	09
V	Design of Synchronous machines and Computer Aided Design Output Equations–choice of loadings– Design of salient pole machines–Design of stator– Design of rotor– Design of damper winding–Design of turbo alternators– Introduction to CAD- Benefits Flowchart methods.	09

If the course is available as Generic Elective then the students of following departments may opt it. **Not applicable**	
Evaluation/Assessment Methodology	
	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
2. Assignments	20
3. Research Project Report Seminar On Research Project Report	-
4. ESE	100
Total:	**150**
Prerequisites for the course:	
Course Outcomes: After studying the above course the student will be able to. CO1: Design considerations of static and rotating electrical machines. CO2: Design considerations of DC Machines Magnetic circuit CO3: Construction details of transformers DC and AC machines. CO4: Design aspects of both DC and AC rotating electrical machines. At the end of the course. CO5: Design the various elements of DC machines, transformers, induction motors and alternators CO6: Design of stator, rotor, damper winding and turbo alternators.	

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: VI**
Credits: 3 **Theory: 3** **Practical: 0**	**Subject: Universal Human Values and Professional Ethics**
Course Code: UVE-601	**Title: Universal Human Values and Professional Ethics**

Course Objectives: The objectives of studying this course are,

1. To reinstate the rich cultural legacy and human values of which we are the custodians.
2. To focus on professional ethics which are broader indicators of desirable actions vis-à-vis undesirable actions?
3. To lay down broader guidelines of values and ethics for internal and external stakeholders.
4. To suggest operational guidelines for value-based and ethical practices in the higher educational institutions leading to implementation and monitoring.
5. To indicate the outcomes of creating a value-based and ethical culture in HEIs.
6. To suggest indicative reinforcement programmes for nurturing human values and ethics in HEIs.

Nature of Paper: AEC

Minimum Passing Marks/Credits: 40% Marks / 3 Credits

L: 3
T: 0
P: 0 (in Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures
I	**Introduction - Need, Basic Guidelines, Content and Process for Value Education** Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.	09

II	**Understanding Harmony in the Human Being - Harmony in Myself** Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programsto ensure Sanyam and Swasthya.	09
III	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship** Understanding harmony in the Family- the basic unit of human interaction, Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay- tripti*; Trust (*Vishwas*) and Respect (*Samman*) as the foundational values of relationship, Understanding the meaning of *Vishwas*; Difference between intention and competence, Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): *Samadhan*, *Samridhi*, *Abhay*, *Sah-astitva*as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society (*AkhandSamaj*), Universal Order (*Sarvabhaum Vyawastha*)- from family to world family!.	09
IV	**Understanding Harmony in the Nature and Existence - Whole existence as Co-existence** Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co- existence (*Sah-astitva*) of mutually interacting units in all- pervasive space, Holistic perception of harmony at all levels of existence.	09
V	**Implications of the above Holistic Understanding of Harmony on Professional Ethics** Natural acceptance of human values, Definitiveness of Ethical Human for Conduct, Basis Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco- friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations.	09
If the course is available as Generic Elective then the students of following departments may opt it. **Not applicable**		
Evaluation/Assessment Methodology		
		Max. Marks

1) Class tasks/ Sessional Examination	10
2) Presentations /Seminar	-
3) Assignments	5
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	35
Total:	**50**

Prerequisites for the course:

Course Learning Outcomes: After undergoing this course, the students will be able to:

1. The learning process for holistic development
2. Impeccable governance
3. Effective institutional management
4. Well laid system of rewards and chastisement
5. Institutional climate where 'rights' enjoy and 'wrongs' are discouraged.
6. Understand Harmony in the Nature and Existence

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: VI**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Power Electronics Lab**
Course Code: SEEE-361P	**Title: Power Electronics Lab**

Course Objectives: The objectives of studying this course are,

- To provide hands on experience with power electronic converter design and testing
- To study the behavior of voltage waveforms of PWM inverter applying various modulation techniques

Minimum Passing Marks/Credits: 50% Marks / 2 Credits

L: 0
T: 0
P: 3 (n Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

S. No	Experiment's List	No. of Labs
Practical-1	To study triggering of power transistor	03
Practical-2	To study triggering of MOSFET	03
Practical-3	To study triggering of IGBT	03
Practical-4	To study bridge inverter using IGBT	03
Practical-5	To study Micro Controller Based Single Phase Cyclo Converter	03
Practical-6	To study MOSFET Based Chopper Motor Controller	03
Practical-7	To study Series Inverter Using MOSFET	03
Practical-8	To study V-I Characteristics of SCR	03
Practical-9	To study Single Phase Half Controlled Bridge Converter	03
Practical- 10	To study three phase fully controlled converter	03

Text Books:

1. M.H. Rashid, "*Power Electronics*", PHI, New Delhi, 2007.
2. P.S. Bimbhra, "*Power Electronics*", Khanna Publishers, New Delhi, 2008.
3. Ned Mohan, M. Underland, William P. Robbins, "*Power Electronics Converters, applications and design*", John Wiley & sons, Singapore, 2001.

Reference Books:

1. M.D. Singh, K.B. Khanchandani, "*Power Electronics*", Tata McGraw Hill, New Delhi, 2007.
2. Cyril W. Lander, "*Power Electronics*", McGraw Hill Book Company, Singapore (1993).
3. Williams B.W., "*Power Electronics Devices, drivers, applications and passive components*", McMillan Press Ltd., London, 1992.

If the course is available as Generic Elective then the students of following departments may opt it.
NO

Evaluation/Assessment Methodology

Max. Marks

1) Class tasks/ Sessional Examination 2) Presentations /Seminar 3) Assignments 4) Research Project Report Seminar On Research Project Report 5) ESE	20 - - - 30
Total:	**50**

Prerequisites for the course:

Course Outcomes: After studying the above course the student will be able to,

CO1: Demonstrate the characteristics and triggering of IGBT, MOSFET, Power transistor and SCR.
CO2: Analyse the performance of inverters using MOSFET and IGBT.
CO3: Understand single phase and three phase controlled converters.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B-Tech**	**Year: III** **Semester: VI**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Microprocessor & Microcontroller Lab**
Course Code: SEEE-362P	**Title: Microprocessor & Microcontroller Lab**

Course Objectives: The objectives of studying this course are,

- To develop skills in designing and conducting experiments related to applications of 8086 microprocessor and 8051 microcontroller.
- Interface different I/Os with Microprocessors

Minimum Passing Marks/Credits: 50% Marks / 2 Credits

L: 0
T: 0
P: 3(n Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
Practical-1	8085 based microprocessor system	03
Practical-2	To perform mathematical operations (addition & subtraction) on two 8-bit numbers	03
Practical-3	To perform multiplication on two 8-bit numbers	03
Practical-4	To perform division on two 8-bit numbers	03
Practical-5	To develop and run a program for finding out the largest number from given two 8-bit numbers	03
Practical-6	To develop and run a program for finding out the smallest number from given two 8-bit numbers	03
Practical-7	To develop and run a program for arranging in ascending order of a given set of 8-bit numbers	03
Practical-8	To develop and run a program for arranging in descending order of a given set of 8-bit numbers	03
Practical-9	To perform conversion of temperature from degree F to degree C	03
Practical10	To perform computation of square root of a given number	03

Prerequisites for the course:

If the course is available as Generic Elective then the students of following departments may opt it., NO

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-

3) Assignments 4) Research Project Report Seminar On Research Project Report 5) ESE	- - 30
Total	**50**
Course Outcomes: After studying the above course the student will be able to,	
CO1: Demonstrate program proficiency using the various addressing modes and data transfer instructions of the target microprocessor. CO2: Apply knowledge of the microprocessor's internal registers and operations by use of a PC based microprocessor simulator. CO3: Interface the processor to external devices.	

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VII

Programme: UG(R) **Class: B-Tech**	**Year: IV** **Semester: VII**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Smart Grid**
Course Code: SEEE-471	**Title: Smart Grid**

Course Objectives: The objectives of studying this course is,

1. To provide students with a working knowledge of fundamentals and development of Smart Grid, from the basic concepts of power systems.

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (n Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Smart Grid:** Evolution of Electric Grid– Need for smart grid– Difference between conventional & smart grid – Overview of enabling technologies– International experience in smart grid deployment efforts– Smart grid road map for INDIA– smart grid architecture.	08
II	**Wide Area Monitoring System:** Fundamentals of synchro phasor technology – concept and benefits of wide area monitoring system– Structure and functions of Phasor Measuring Unit (PMU) and Phasor Data Concentrator (PDC)–Road Map for synchro phasor applications (NAPSI)–Operational experience and Blackout analysis using.	08
III	**Smart Meters:** Features and functions of smart meters–Functional specification–category of smart meters– AMR and AMI drivers and benefits– AMI protocol– Demand Side Integration-Peak load, Outage and Power Quality management.	08
IV	**Information and Communication:** Overview of smart grid communication system– Modulation and Demodulation techniques-Radio communication–Mobile communication–Power line communication– Optical fiber communication – Communication protocol for smart grid.	08

V	**Smart Grid Applications:** Overview and concept of renewable integration – role of protective relaying in smart grid– House Area Network– Advanced Energy Storage Technology - Flow battery– Fuel cell–SMES–Super capacitors– Plug–in Hybrid electric Vehicles– Cyber Security requirements–Smart grid information model.	08

If the course is available as Generic Elective then the students of following departments may opt it.
Not applicable

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report	-
5) Seminar On Research Project Report	-
6) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes: After undergoing this course, the students will be able to:
CO1: Understand smart grids and analyse the smart grid policies and developments in smart grids.
CO2: Develop concepts of smart grid technologies in hybrid electrical vehicles etc.
CO3: Understand smart substations, feeder automation, GIS etc.
CO4: Analyse micro grids and distributed generation systems.
CO5: Analyse the effect of power quality in smart grid and to understand latest developments in ICT for smart grid.
CO6: To ensure a transparent, sustainable and environmental-friendly system operation.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VII

Programme: UG(R) **Class: B-Tech**	**Year: IV** **Semester: VII**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Industrial Electric Drives Lab**
Course Code: SEEE-471P	**Title: Industrial Electric Drives Lab**

Course Objectives: The objectives of studying this course is,

1. Students will be able to learn simulations experiments on introduction to PLC, introduction to digital I/O interface to PLC and ladder logic and applications of PLC.
2. To impart knowledge about fundamentals of Electric drives and control, operational strategies of dc and ac motor drives as per different quadrant operations.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 2 Credits

L: 0
T: 0
P: 3 (in Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
Practical-1	Introduction to PLC and Introduction to digital I/O interface to PLC	03
Practical-2	Introduction to ladder logic	03
Practical-3	PLC On-Delay Timer Instruction	03
Practical-4	PLC Off-Delay Timer Instruction	03
Practical-5	PLC Count-Up instruction	03
Practical-6	PLC Count-Down instruction	03
Practical-7	Garage Shutter Opening and Closing Using PLC	03
Practical-8	Container Filling Process Using PLC	03

If the course is available as Generic Elective then the students of following departments may opt it.
Not applicable

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	30
Total:	**50**

Prerequisites for the course:

Course Learning Outcomes:

After undergoing this course, the students will be able to:

1. Industrial Electric Drives Lab deals with the simulations experiments on introduction to Programmable Logic Controller (PLC).
2. Introduction to digital I/O interface to PLC and ladder logic and, applications of PLC.
3. Student should be able to understand the design concepts of transformers and know about how to design the parts
4. To apply their knowledge to prepare control schemes as per different types of motors used in industries.
5. To estimate & solve harmonic and power factor related problems in controlling AC and DC drives.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

Programme: UG(R) **Class: B-Tech**	**Year: IV** **Semester: VIII**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Electric Drives**
Course Code: SDEE-481	**Title: Electric Drives**

Course Objectives: The objectives of studying this course are,

1. To acquire a comprehensive knowledge on drives, digital control and applications of electric drives.
2. To provide strong foundation to asses performance of different industrial drives considering issues such as, energy efficiency, power quality, economic justification, environmental issues, and practical viabilities
3. To familiarize the operation principles, and design of starting, braking, and speed control arrangements for electric motors and their applications.
4. To familiarize the operation principles, and design of starting, braking, and speed control arrangements for electric motors and their applications.

Nature of Paper: DSE

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (In Hours/Week)
Theory – 6 Practical- NIL

Unit	Contents	No. of Lectures Allotted
I	**Introduction**: Electric Drives and its parts, advantages of electric drives, Classification of electric drives, Speed- torque conventions and multi-quadrant operations, Constant torque and constant power operation, Types of loads, Load torque: components, nature and classification.	09
II	**Dynamics of Electric Drive:** Dynamics of motor-load combination, Steady state stability of Electric Drive, Transient stability of electric drive; Selection of Motor Power rating: Thermal model of motor for heating and cooling, classes of motor duty, determination of motor power rating for continuous duty, short time duty and intermittent duty., Load equalization.	09
III	**Electric Braking:** Purpose and types of electric braking, braking of dc, three phase induction and synchronous motors, Dynamics During Starting and Braking: Calculation of acceleration time and energy loss during starting of dc shunt and three phase induction motors, methods of reducing energy loss during starting. Energy relations during braking, dynamics during braking.	09

IV	**Power Electronic Control of DC Drives:** Single phase and three phase-controlled converter fed separately excited dc motor drives (continuous conduction only), dual converter fed separately excited dc motor drive, rectifier control of dc series motor. Supply harmonics, power factor and ripples in motor current Chopper control of separately excited dc motor and dc series motor.	09
V	**Power Electronic Control of AC Drives:** Three Phase induction Motor Drive: Static Voltage control scheme, static frequency control scheme (VSI, CSI, and cycloconverter based) static rotor resistance and slip power recovery control schemes. Three Phase Synchronous motor: Self-controlled scheme. Special Drives: Switched Reluctance motor, Brushless dc motor. Selection of motor for particular applications**.**	09

If the course is available as Generic Elective, then the students of following departments may opt it.
Not applicable

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes: After undergoing this course, the students will be able to:

CO1: Understand the operation of electric drives and its classification.
CO2: Select a motor on the basis of power rating
CO3: Understand the concept of electric braking
CO4: Understand Power Electronic Control of DC/AC Drives
CO5: Identify the critical areas in application levels, and derive typical solutions.
CO6: Gain knowledge about the working principle of Power Electronic Control of AC Drives.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

Programme: UG(R) **Class: B-Tech**	**Year: IV** **Semester: VIII**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Analog & Digital Communication**
Course Code: SDEE-482	**Title: Analog & Digital Communication**

Course Objectives: The objectives of studying this course are,
1. To develop ability to analyze system requirements of analogue and digital communication systems.
2. To understand the generation, detection of various analogue and digital modulation techniques.

Nature of Paper: DSE

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (In Hours/Week)
Theory – 6 Practical- NIL

Unit	Contents	No. of Lectures Allotted
I	**Amplitude Modulation:** Elements of communication system and its limitations, Amplitude modulation and detection, Generation and detection of DSB-SC, SSB and vestigial side band modulation, carrier acquisition AM transmitters and receivers, Super heterodyne Receiver, IF amplifiers, AGC circuits, Frequency Division multiplexing.	09
II	**Angle Modulation:** Angle Modulation: Basic definition, Narrow-Band and wideband frequency modulation, transmission bandwidth of FM signals, Generation and detection of frequency modulation, Generation and detection of Phase Modulation. Noise: External noise, internal noise, noise calculations, signal to noise ratio.	09
III	**Pulse Modulation:** Introduction, sampling process, Analog Pulse Modulation Systems, Pulse Amplitude Modulation (PAM), Pulse width modulation (PWM) and Pulse Position Modulation (PPM). **Waveform coding Techniques:** Discretization in time and amplitude, Quantization process, quantization noise, Pulse code Modulation, Differential Pulse code Modulation, Delta Modulation and Adaptive Delta Modulation.	09
IV	**Digital Modulation Techniques:** Types of digital modulation, waveforms for amplitude, frequency and phase shift keying, coherent and non-coherent methods for the generation of ASK, FSK and PSK.	09

V	**Time Division Multiplexing:** Fundamentals, Electronic Commutator, Bit/byte interleaving, TI carrier system, synchronization and signaling of TI, TDM and PCM hierarchy, synchronization techniques. **Introduction to Information Theory:** Measure of information, Entropy & Information rate, channel capacity, Hartley Shannan law, Huffman coding, Shannan Fano coding.	09

If the course is available as Generic Elective, then the students of following departments may opt it. **Not applicable**

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes: After undergoing this course, the students will be able to:

CO1. Understand the concepts of analog modulation and demodulation techniques.
CO2. Learn the function of radio transmitters and receivers and familiarize with noise performance of various receivers.
CO3. Understand various digital modulation schemes.
CO4. Understand and analyze various digital pass band data transmission schemes.
CO5. Understanding data transmission using spread spectrum and error coding techniques.
CO6. Identify the critical areas in Digital Modulation Techniques.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

Programme: Under Graduate **Class: B-Tech**	**Year: IV** **Semester: VIII**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Fundamental of Electric Vehicles**
Course Code: SDEE-483	**Title: Fundamental of Electric Vehicles**

Course Objectives: The objectives of studying this course are,

1. To acquire knowledge on the fundamental concepts, principles, and analysis of hybrid electric vehicles.
2. Electric vehicles are more efficient, and that combined with the electricity cost means that charging an electric vehicle is cheaper than filling petrol or diesel for your travel requirements.

Nature of Paper: DSE

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (In Hours/Week)
Theory – 6 Practical- NIL

Unit	Contents	No. of Lectures Allotted
I	Components, vehicle mechanics, Roadway fundamentals, vehicle kinetics, Dynamics of vehicle motion, Propulsion System Design.	09
II	Basics: Types, Parameters, Capacity, Discharge rate, State of charge, state of Discharge, Depth of Discharge, Technical characteristics, Battery pack Design, Properties of Batteries	09
III	Motor and Engine rating, Requirements, DC machines, three phase A/c machines, Induction machines, permanent magnet machines, switched reluctance machines.	09
IV	Transmission configuration, Components: gears, differential, clutch, brakes regenerative braking, motor sizing.	09
V	Types: series, parallel and series-parallel configuration, Design, Drive train, sizing of components.	09

If the course is available as Generic Elective, then the students of following departments may opt it.
Not applicable

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
2) Assignments	20
3) Research Project Report / Seminar On Research Project Report	-
4) ESE	100
Total:	**150**

Prerequisites for the course:
Course Learning Outcomes: After undergoing this course, the students will be able to:
CO1: Understand the fundamental concepts and techniques used in electric vehicles (EVs). CO2: Understand basic principle, operation and performance of EVs. CO3: Interpret working of different configurations of electric vehicles and its components, hybrid vehicle configuration, performance analysis and Energy Management strategies in HEVs. CO4: Explain the use of different energy storage devices used for hybrid electric vehicles, their technologies and control and select appropriate technology CO5: Analyze the use of different power electronics devices and electrical machines in hybrid electric vehicles. Understand basic of transmission configuration.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

Programme: Under Graduate **Class: B-Tech**	**Year: IV** **Semester: VIII**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Bio-Medical Instrumentation**
Course Code: SDEE-484	**Title: Bio-Medical Instrumentation**
Course Objectives: The objectives of studying this course are, 1. Analyze the scopes and roles of Biomedical Engineering. 2. Utilize biomedical instrumentation modules 3. Gain the knowledge about Biomedical Engineering	
Nature of Paper: DSE	
Minimum Passing Marks/Credits: 40% Marks / 4 Credits	
L: 3 T: 1 P: 0(In Hours/Week) Theory – 6 Practical- NIL	

Unit	Contents	No. of Lectures
I	Introduction to Biomedical Instrumentation: Problems encountered in measurements of living systems, Block diagram of Biomedical Instrumentation System & its components and Biomaterials for medical instrument applications. Transducers use for biomedical applications. Bio electric potential: Genesis, Propagation and Distribution (ECG, EEG and EMG).	09
II	Bio-potential Electrodes: Basic types: Micro, Skin surface and needle electrodes and Biochemical transducers: Blood gas, PH and specific ions electrodes. The cardiovascular system and measurements: Heart and cardiovascular system and its block diagram, Blood pressure, Blood flow & Heart sound characteristics and their measurements. Electrocardiography, ECG leads configurations and recordings of ECG.	09
III	The Nervous System: The anatomy of nervous system, Neuronal communication, EPSP & IPSP. Electroencephalogram characteristic features, Measurement scheme for EEG and 10-20 electrode configuration system. Human Body & Skin Temperature Measurement: Temperature measurements using infrared sensors and other sensors, Ultrasonic measurements and its applications in Blood flow measurement and soft tissue imaging.	09
IV	Automation of biochemical tests, Instrumentation for X- Ray Machine, CAT, Interfacing of computer with medical instrument, MRI imaging and its applications in biomedical engineering.	09

V	Patient care monitoring: Elements of intensive care unit, Organization of the Hospital for patient-care monitoring, Pace-maker systems, their types and modes, Defibrillators and their types. Shock hazards from electrical equipment and safety measures. Bio-telemetry and its applications in patient care and sports.	09

If the course is available as Generic Elective, then the students of following departments may opt it.
Not applicable

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes: After undergoing this course, the students will be able to:

CO1: Understand the physiological system of the body and also an understanding on the generation of various bioelectric signals like ECG, EEG and EMG, their characteristic features and concepts of transduction.
CO2: Remember the various techniques and clinical instruments available for the measurement of various physiological parameters.
CO3: Apply the various techniques and clinical instruments available for the measurement of various Nervous system parameters.
CO4: Evaluate fundamentals of medical instrumentation along with their working principle.
CO5: Differentiate patient monitoring system, there types and safety hazards.
CO6: Understand the bio-telemetry and its applications in patient care and sports.

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Evaluation Scheme

Computer Science & Engineering

Evaluation Scheme – Bachelor of Technology (Computer Science & Engineering)
Year: I / Semester: I

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	ENAS-111	MATHEMATICAL THINKING WITH CALCULUS AND LINEAR ALGEBRA	Th	Core-1	3	1	0	4	30	20	50	100	150
2.	ENAS-112	MODERN PHYSICS IN ENGINEERING	Th	Core -2	3	1	0	4	30	20	50	100	150
	ENEE-111	ELECTRICAL & ELECTRONICS IN THE MODERN WORLD											
3.	ENCS-112	SMART AND SECURE TECHNOLOGIES	Th	Core -3	3	1	0	4	30	20	50	100	150
4.	ENCS-111	STRUCTURED PROGRAMMING AND PROBLEM SOLVING IN C	Th	VAC-1	3	1	0	4	30	20	50	100	150
5.	ENAS-114	PROFESSIONAL COMMUNICATION AND DIGITAL FLUENCY	Th	AECC-1	3	1	0	4	30	20	50	100	150
	ENHU- 112	ENVIRONMENT, ECOLOGY AND SUSTAINABILITY		AECC-2									
6.	ENAS-112P	MODERN PHYSICS IN ENGINEERING LAB	P	LAB-1	0	0	2	1	0	15	15	35	50
	ENEE-111P	ELECTRICAL & ELECTRONICS IN THE MODERN WORLD LAB											
7.	ENCS-111P	PROGRAMMING WITH C LAB: HANDS ON LOGIC BUILDING	P	LAB-2	0	0	2	**1**	0	15	15	35	50
8.	ENAS-114 P	PROFESSIONAL COMMUNICATION AND DIGITAL FLUENCY LAB	P	LAB-3	0	0	2	1	0	15	15	35	50
	ENHU- 112P	ENVIRONMENT, ECOLOGY AND SUSTAINABILITY LAB											
9.	ENME-111P	RAPID PROTOTYPING LAB	P	LAB-4	0	0	2	2	0	15	15	35	50
10.	ENPH-111	SPIRITUAL AND CULTURAL HERITAGE: INDIAN EXPERIENCE	P	AC	0	0	0	NC*	0	25*	25*	0	25*

11.	NECC -112*	UNIVERSITY SOCIAL RESPONSIBILITY - COMMUNITY OUTREACH	P	AC	0	0	0	NC*	0	25*	25*	0	25*
12.	SPNC-111*	SPORTS	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**15**	**5**	**8**	**25**	**150**	**160**	**310**	**640**	**950**

TH- Theory paper, P-Practical, L-Lecture, T-Tutorials, C-Credit, AECC – Ability Enhancement Compulsory Course, AC – Audit Courses, NC*-No Credit Course, CT – Class Test (Sessional Examinations), TA – Teacher's Assessment, ESE – End Semester Examinations.
University Social Responsibility& Sports - Community Outreach and Sports, Spiritual And Cultural Heritage: Indian Experience are Non-Credit Qualifying Courses. Their marks will not be added in final marks.

Note: NCC is offered as General Elective.

Evaluation Scheme – Bachelor of Technology (Computer Science & Engineering)
Year: I / Semester: II

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	ENAS-121	APPLIED DIFFERENTIAL EQUATIONS	Th	Core-4	3	1	0	4	30	20	50	100	150
2.	ENAS-122	MODERN PHYSICS IN ENGINEERING	Th	Core-5	3	1	0	4	30	20	50	100	150
	ENEE-121	ELECTRICAL & ELECTRONICS IN THE MODERN WORLD											
3.	ENCS-123	DATA STRUCTURE AND ALGORITHM TECHNIQUES	Th	Core-6	3	1	0	4	30	20	50	100	150
4.	ENCS-121	FUNDAMENTAL CONCEPTS AND PROBLEM SOLVING WITH PYTHON	Th	VAC-2	3	1	0	4	30	20	50	100	150
5.	ENAS-124	PROFESSIONAL COMMUNICATION AND DIGITAL FLUENCY	Th	AECC-2	3	1	0	4	30	20	50	100	150
	ENHU -122	ENVIRONMENT, ECOLOGY AND SUSTAINABILITY		AECC-1									
6.	ENAS-122P	MODERN PHYSICS IN ENGINEERING LAB	P	LAB-6	0	0	2	1	0	15	15	35	50
	ENEE-121P	ELECTRICAL & ELECTRONICS IN THE MODERN WORLD LAB											

7.	ENCS-121P	FUNDAMENTAL CONCEPTS AND PROBLEM SOLVING WITH PYTHON LAB	P	LAB-7	0	0	2	1	0	15	15	35	50
8.	ENAS-124P	PROFESSIONAL COMMUNICATION LAB	P	LAB-8	0	0	2	1	0	15	15	35	50
	ENHU -122P	ENVIRONMENT, ECOLOGY AND SUSTAINABILITY LAB											
9.	ENCS-123P	DATA STRUCTURE LAB	P	LAB-10	0	0	2	1	0	15	15	35	50
10.	ENHW-121	HEALTH AND WELLNESS	P	AC	0	0	0	NC*	0	25*	25*	0	25*
11.	NECC-121*	INDUSTRIAL VISIT / SEMINAR ON THE REPORT OF VISIT	P	AC	0	0	0	NC*	0	25*	25*	0	25*
12.	NECC -122*	UNIVERSITY SOCIAL RESPONSIBILITY - COMMUNITY OUTREACH	P	AC	0	0	0	NC*	0	25*	25*	0	25*
13.	SPWC-121	SPORTS	P	SEC	0	0	2	1	0	0	0	25	25
Total					**15**	**5**	**10**	**25**	**150**	**160**	**310**	**665**	**975**

TH- Theory paper, P-Practical, L-Lecture, T-Tutorials, C-Credit, AECC – Ability Enhancement Compulsory Course, AC – Audit Courses, NC*-No Credit Course, CT – Class Test (Sessional Examinations), TA – Teacher's Assessment, ESE – End Semester Examinations.
University Social Responsibility - Community Outreach and Sports, Industrial Visit, Health and Wellness are Non-Credit Qualifying Courses. Their marks will not be added in final marks.

Note: NCC is offered as General Elective.

Evaluation Scheme – Bachelor of Technology (Computer Science & Engineering)
Year: II / Semester: III

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	RTAS-231	Engineering Mathematics-III	Th	Core 7	3	1	0	**4**	30	20	50	100	**150**
	RESE-231-238	Engineering Science Open Elective											
2.	RTCS-231	Operating System	Th	Core 8	3	1	0	**4**	30	20	50	100	**150**
3.	RTCS-232	Digital Logic System	Th	Core 9	3	1	0	**4**	30	20	50	100	**150**
4.	RTCS-233	Theory of Computations	Th	Core 10	3	1	0	**4**	30	20	50	100	**150**
5.	RSCS -231	Computer Organization & Architecture	Th	SEC-3	3	0	0	**2**	10	5	15	35	**50**
6.	RTCS-231P	Operating System Lab	P	Lab-11	0	0	3	**2**	0	15	15	35	**50**

7.	RTCS-232P	Digital Logic System Lab	P	Lab-12	0	0	3	**2**	0	15	15	35	**50**
8.	RTCS-233P	Theory of Computations Lab	P	Lab-13	0	0	3	**2**	0	15	15	35	**50**
9.	RSCS-232P	Advance Python Programming Lab	P	AECC-3	0	0	3	**2**	0	15	15	35	**50**
10.	*NECC-232	University Social Responsibility - Community Outreach	P	AC	0	0	0	NC*	0	25*	25*	0	25*
11.	SPT-231	SPORTS	P	AC	0	0	0	NC*	0	50*	50*	0	50*
Total					**15**	**04**	**12**	**26**	**130**	**145**	**275**	**575**	**850**

Th- Theory, L-Lecture, T-Tutorials, P-Practical (Labs), C-Credit, CT-Class Test (Sessional), TA-Teacher's Assessment (Attendance, Assignments, Tutorials, Class Tests, Quiz etc.),ESE-End Semester Examinations, NC*-Non-Credit Course, AC-Audit Course, SEC – Skill Enhancement Course.

NECC-232*, & SPT-231* are Non-credit courses and will be evaluated on the basis of a report presented by the student of his/her industrial visits, social visits ,awareness campaigns, rallies and participation in sports activities respectively during the semester. Student needs to qualify it but the marks will not be added in total marks.

Note: NCC is offered as General Elective.

Evaluation Scheme – Bachelor of Technology (Computer Science & Engineering)
Year: II / Semester: IV

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	RESE 241-248 RTAS-241	Engineering Science Open Elective Engineering Mathematics-III	Th	Core 11	3	1	0	4	30	20	50	100	**150**
2.	RTCS-241	Java Programming	Th	Core 12	3	1	0	4	30	20	50	100	**150**
3.	RTCS-242	Data Structure using C	Th	Core 13	3	1	0	4	30	20	50	100	**150**
4.	IEMM-402/ ASNL-402	**VAC-3**	Th	VAC- 3	3	0	0	2	10	5	15	35	**50**
5.	RDCS-241/ RDCS-244	**DSE-I**	Th	DSE-1	3	1	0	4	30	20	50	100	**150**
6.		Generic Elective-I	Th	GE-1	4	0	0	4	30	20	50	100	**150**
7.	RTCS-241P	Java Programming Lab	P	Lab-14	0	0	3	2	0	15	15	35	**50**
8.	RTCS-242P	Data Structure using C Lab	P	Lab-15	0	0	3	2	0	15	15	35	**50**
9.	RTCS-243P	OOPs Lab with C++	P	Lab-16	0	0	3	2	0	15	15	35	**50**
10.	NECC-241	Industrial Visit/Seminar/ Presentation of the report of visit	P	AC	*0*	*0*	*0*	*NC**	*0*	*25**	*25**	*0*	*25**
11.	NECC-242	University Social Responsibility - Community Outreach	P	AC	*0*	*0*	*0*	*NC**	*0*	*25**	*25**	*0*	*25**
12.	SPT-PC-111	SPORTS	P	Lab 17	0	0	3	2	0	15	15	35	50

Total			**19**	**4**	**12**	**30**	**160**	**165**	**325**	**675**	**1000**
#Minor Certificate Paper-I			3	1	0	4	30	20	50	100	150

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessional), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, DSE- Discipline Specific Elective, SEC : Skill Enhancement Course, Th- Theory, ESE- End Semester Examination, AC- Audit course

***Note:** NECC-241, NECC-242 & SPT-241 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies & participation in sports activity respectively during the semester. Student needs to qualify it but the marks will not be added in total marks

Discipline Specific Electives –I	1. RDCS- 241 OOPs 2. RDCS-242 Data Analytics 3. RDCS-243 Distributed System 4. RDCS-244 Basics of IOT
Generic Electives-I	This subject will be opted by student from other School of the IIMT University
Value Added Course	1. IEMM-402 Indian Ethos and Modern Management 2. ASNL-402 Ancient Sanskrit Language (Central Sanskrit University, Delhi)

Most Important regarding Internship: A minimum of 4-5 weeks internship is to be completed during summer break & its assessment will be done in 5th Semester.

#Minor Certification will be choice based and the student choosing any minor certification course has to clear all the three papers in three semesters (IV/ V/ VI Semester).

Note: NCC is offered as General Elective.

Evaluation Scheme – Bachelor of Technology (Computer Science & Engineering)
Year: III / Semester: V

S. No	Subject Code	Subject Name	Evaluation Scheme									
			Periods			Internal Marks			External Marks		Total Marks	Credits
			L	T	P	CT	TA	IP	ET	EP		
1	SECS-351	Design and Analysis of Algorithm	3	1	0	30	20	0	100	0	**150**	**4**
2	SECS-352	Database Management System	3	1	0	30	20	0	100	0	**150**	**4**
3	SECS-353	Discrete Structures & Theory of Logic	3	1	0	30	20	0	100	0	**150**	**4**
4	SDCS-351-4	DSE-II	3	1	0	30	20	0	100	0	**150**	**4**
5	SECS-351P	Design and Analysis of Algorithm Lab	0	0	3	0	0	20	0	30	**50**	**2**
6	SECS-352P	Database Management System Lab	0	0	3	0	0	20	0	30	**50**	**2**
7	SECS-353P	Discrete Structures & Theory of Logic Lab	0	0	3	0	0	20	0	30	**50**	**2**
8	SECS-354P	Internship / Mini Project Assessment	0	0	2	0	0	50	0	0	**50**	**2**
9	NECC-351	Research Project I (Industry Training/Internship Survey)	*0*	*0*	*2*	*0*	*0*	*50**	*0*	*0*	*50**	*NC**
10	NECC-352	University Social Responsibility	*0*	*0*	*0*	*0*	*0*	*25**	*0*	*0*	*25**	*NC**

11	SPT-351	SPORTS	*0*	*0*	*0*	*0*	*0*	*50**	*0*	*0*	*50**	*NC**
		Grand Total	**12**	**04**	**13**	**120**	**80**	**110**	**400**	**90**	**800**	**24**

L- Lecture, T- tutorials, P- Practical (Labs), CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), IP- Internal Practical, ET- External Theory, EP- external Practical, NC- Non-Credit Course

***Note:**NECC-351,NECC-352 & SPT-351 are Noncredit courses (Audit Courses) and will be evaluated on the basis of social visits/awareness campaigns/ awareness rallies & participation in sports activity respectively during the semester. Student needs to qualify it but the marks will not be added in total marks

Engineering Courses (Core)	1. Design and Analysis of Algorithm 2. Database Management System 3. Discrete Structures & Theory of Logic
Discipline Specific Elective-II	1. Machine Learning Techniques 2. Application of Soft Computing 3. Augmented & Virtual Reality 4. Human Computer Interface
Skill Enhancement Courses	University Social Responsibility, SPORTS, Internship / Mini Project Assessment,

Evaluation Scheme – Bachelor of Technology (Computer Science & Engineering)
Year: III / Semester: VI

S. No	Subject Code	Subject Name	Evaluation Scheme									
			Periods			Internal Marks			External Marks		Total Marks	Credits
			L	T	P	CT	TA	IP	ET	EP		
1	SECS-361	Computer Networks	3	1	0	30	20	0	100	0	**150**	**4**
2	SECS-362	Compiler Design	3	1	0	30	20	0	100	0	**150**	**4**
3	SDCS-361-4	DSE-III	3	1	0	30	20	0	100	0	**150**	**4**
4	UVE-601	Universal Human Values & Professional Ethics	*3*	*0*	*0*	*10*	*05*	*0*	*35*	*0*	***50***	***3***
5	SECS-361P	Computer Networks Lab	0	0	3	0	0	20	0	30	**50**	**2**
6	SECS-362P	Compiler Design Lab	0	0	3	0	0	20	0	30	**50**	**2**
7	SECS-363P	Mini Project	0	0	3	0	0	50	0	0	**50**	**2**
8	NECC-365	MOOCS (SWAYAM/NPTEL)	0	0	2	0	0	50	0	0	**50**	**2**
9	NECC-361	Research Project(Industry Training/ Internship Survey)	*0*	*0*	*2*	*0*	*0*	*50**	*0*	*0*	*50**	*NC**
10	NECC-362	University Social Responsibility	*0*	*0*	*0*	*0*	*0*	*25**	*0*	*0*	*25**	*NC**
11	*SPT-361	SPORTS	*0*	*0*	*0*	*0*	*0*	*50**	*0*	*0*	*50**	*NC**
		Grand Total	**12**	**03**	**13**	**100**	**65**	**140**	**335**	**60**	**700**	**23**

L- Lecture, T- tutorials, P- Practical (Labs), CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), IP- Internal Practical, ET- External Theory, EP- external Practical, NC- Non Credit Course

***Note:** NECC-361, NECC-362 & SPT-361 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness

rallies & participation in sports activity respectively during the semester. Student needs to qualify it but the marks will not be added in total marks	
Engineering Courses (Core)	1.Computer Networks 2. Compiler Design
Discipline Specific Elective-III	1. Big Data 2. Image Processing 3. Real Time Systems 4. Data Compression
Ability Enhancement Courses	## Universal Human Values & Professional Ethics is a non-credit course (Audit Course)
Skill Enhancement Courses	University Social Responsibility, SPORTS, Internship / Mini Project Assessment, Python Programming, MOOCS (SWAYAM/NPTEL)

Evaluation Scheme – Bachelor of Technology (Computer Science & Engineering)
Year: IV / Semester: VII

S. No	Subject Code	Subject Name	Evaluation Scheme									
			Periods			Internal Marks			External Marks		Total Marks	Credits
			L	T	P	CT	TA	IP	ET	EP		
1	SECS-471	Distributed Systems	3	1	0	30	20	0	100	0	**150**	**4**
2		GE-2	3	1	0	30	20	0	100	0	**150**	**4**
3	SECS-471P	Distributed Systems Lab	0	0	3	0	0	20	0	30	**50**	**2**
4	SECS-472P	Minor Project Lab	0	0	8	0	0	40	0	60	**100**	**4**
5	SECS-474P	Internship / Mini Project Assessment	0	0	2	0	0	50	0	0	**50**	**2**
6	NECC-475	MOOCS (SWAYAM/NPTEL)	0	0	2	0	0	50	0	0	**50**	**2**
7	NECC-472	University Social Responsibility	*0*	*0*	*0*	*0*	*0*	*25**	*0*	*0*	*25**	*NC**
8	SPT-471	SPORTS	*0*	*0*	*0*	*0*	*0*	*50**	*0*	*0*	*50**	*NC**
		Grand Total	**06**	**02**	**15**	**60**	**40**	**160**	**200**	**90**	**550**	**18**

L- Lecture, T- tutorials, P- Practical (Labs), CT- Class Test (Sessional), TA- Teacher's Assessment (Assignments, Tutorials), IP- Internal Practical, ET- External Theory, EP- external Practical, NC- Non-Credit Course

*Note: NECC-352 & SPT-351 is a Non-credit course (Audit Courses) and will be evaluated on the basis of social visits/awareness campaigns/ awareness rallies & participation in sports activity respectively during the semester. Student needs to qualify it but the marks will not be added in total marks

Engineering Courses (Core)	1. Distributed Systems
Skill Enhancement Courses	University Social Responsibility, SPORTS, Internship / Mini Project Assessment, Minor Project Lab, Seminar/ Presentation

Evaluation Scheme – Bachelor of Technology (Computer Science & Engineering)
Year: IV / Semester: VIII

S. No	Subject Code	Subject Name	Evaluation Scheme									
			Periods			Internal Marks			External Marks		Total Marks	Credits
			L	T	P	CT	TA	IP	ET	EP		
1		GE-3	3	1	0	30	20	0	100	0	**150**	**4**
2	SDCS-481-4	DSE-IV	3	1	0	30	20	0	100	0	**150**	**4**
3	SECS-481P	Major Project Lab	0	0	20	0	0	100	0	150	**250**	**10**
		Grand Total	**06**	**02**	**20**	**60**	**40**	**100**	**200**	**150**	**550**	**18**
L- Lecture, T- tutorials, P- Practical (Labs), CT- Class Test (Sessional), TA- Teacher's Assessment (Assignments, Tutorials), IP- Internal Practical, ET- External Theory, EP- external Practical, NC- Non-Credit Course												
*Note: NECC-352 & SPT-351 is a Non-credit course (Audit Courses) and will be evaluated on the basis of social visits/awareness campaigns/ awareness rallies & participation in sports activity respectively during the semester. Student needs to qualify it but the marks will not be added in total marks												
Discipline Specific Elective-IV		1. Mobile Computing 2. Internet of Things 3. Cloud Computing 4. Block chain Architecture Design										
Skill Enhancement Courses		Major Project Lab										

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CBCS: Statement of Credit distribution (w.e.f: Session 2024-25)

College/School: School of Engineering & Technology **Programme: B.Tech** **Duration: 8 Semester Annual/Semester: Semester**									**Credit range: 160-190 (Suggested by CBCS Committee)**		
Course	**Credit**	**Semester**	**Core Course Major**	**DSE Minor**	**AECC**	**SEC**	**GE (Th 4) Interdisciplinary**	**General Elective**	**Value Added Course (VAC)**	**Industrial Training/ Survey / Research Project**	**Total Credits**
No Exit Allowed	26	I	C-1 (4 Credit) C-2 (4 Credit)+P-01(1Credit) C-3 (4 Credit)+P-02(1Credit)		AECC-1 (4Credit)+ P-04 (1Credit)	SEC-1 P-(2 Credit)		NCC	VAC-1 (4 Credit) + P-9(1Credit)		26
	28	II	C-4 (4 Credit) C-5 (4 Credit)+P-05(1Credit) C-6 (4 Credit)+P-06(2Credit) P-8 (1 Credit)		AECC-2 (4Credit)+ P-04 (1Credit)	SEC-2 P-(2 Credit)		NCC	VAC-2 (4 Credit) + P-9(1Credit)		28
Certificate in Engineering	26	III	C-07(4 Credit) C-8 (4 Credit)+P-10(2 Credit) C-9 (4 Credit)+P-11(2 Credit) C-10 (4Credit)+P-12(2 Credit)		AECC-3 (P- 2Credit)	SEC-3 (2 Credit)		NCC			26
	28	IV	C-11(4 Credit) C-12 (4 Credit)+P-13(2 Credit) C-13 (4 Credit)+P-14(2 Credit)	DSE-1 (4 Credit)			GE-1 (4 Credit)	NCC	VAC-3 (2 Credit)		28

			P-15(2 Credit)								
Diploma in Engineering	26	V	C-14 (4 Credit)+P-16(2 Credit) C-15 (4 Credit)+P-17(2 Credit) C-16 (4 Credit)+P-18(2 Credit)	DSE-2 (4 Credit)		SEC-4 (2 Credit)		NCC		INT-1 (2 Credit) RP-I (NC*)	26
	20	VI	C-17 (4 Credit)+P-19(2 Credit) C-18 (4 Credit)+P-20(2 Credit)	DSE-3 (4 Credit)	AECC-4 (2 Credit)	SEC-5 (2 Credit)		NCC		RP-II(NC*)	20
B.Tech (Degree)	18	VII	C-19 (4 Credit)+P-21(2 Credit)			SEC-6 (2 Credit)	GE-2 (4 Credit)	NCC		INT-2 (2 Credit) Minor Project (4 Credit)	18
	18	VIII		DSE-4 (4 Credit)			GE-3 (4 Credit)	NCC		Major Project (10 Credit)	18
			19(Th)*4(C) = 76 04(Pr)*01(C) = 04 13(Pr)*2(C) = 26 **Total = 106**	4(Th)*4(C) =16 **Total =16**	02(Th)*04(C)=8 02(Pr)*01(C)=02 01(Pr)*02(C)=02 01(Th)*02(C)=02 **Total =14**	02(Pr)*02(C)=4 04(Th)*02(C)=8 **Total =12**	03(Th)*04(C)=12 **Total =12**		02(Th)*04(C)=8 02(Pr)*01(C)=02 01(Th)*02(C) =02 **Total =12**	2+2+4+10=18 **Total =18**	**190**

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IMTU-NEP Implementation: (w.e.f. Session 2024-25) **(B.Tech Computer Science & Engineering)**

Programme	Year	Semester (15)weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester	Prerequisite	Elective (For other faculty)
BACHELOR OF TECHNOLOGY – COMPUTER SCIENCE & ENGINEERING	FIRST YEAR	SEMESTER -I	i) Core-1 (Th.4C)	4	5	45	Engineering Mathematics –I	5		SOBST
			ii) AECC-1 (Th.4 C+ P 1 C)	4 1	4 3	45 30	Effective Engineering Communication/ Environment and Ecology Effective Engineering Communication Lab/ Environment and Ecology Lab	5		SOAH
			iii) Core-2 (Th.4 C + P 1 C)	4 1	5 3	45 30	Engineering Physics / Engineering Chemistry Engineering Physics Lab / Engineering Chemistry Lab	5		SOBST
			iv) Core-3 (Th.4 C)	4	5	45	Introduction to Electrical and Electronics Engineering / Fundamentals of Mechanical and Mechatronics system	5		
			v) VAC-1 (Th.4 C + P 1 C)	4 1	5 3	45 30	Structured Programming and Problem Solving in C Structured Programming and Problem Solving in C lab	5		
			vi) SEC-1(P 2C)/ LAB-4	2	3	30	Introduction to CNC and 3-D Printer Lab / Introduction to Electrical and Electronics Engineering Lab			
			vii) LAB-5 (P 1 C)	1	3	30	Mechanical Workshop Lab / Engineering Graphics & Design Lab			SOBST
			viii) Audit Course	NC	-	-	University Social Responsibility - Community Outreach			
			ix) Audit Course	NC	-	-	Sports			

		SEMESTER - II	i) Core-4 (Th4C)	4	5	45	Engineering Mathematics –II	5		SOBST
			ii) AECC-2 (Th4 C+ P 1 C)	4 1	4 3	45 30	Environment and Ecology / Effective Engineering Communication Environment and Ecology Lab / Effective Engineering Communication Lab	5		SOAH
			iii) Core-5 (Th4 C + P 1 C)	4 1	5 3	45 30	Engineering Chemistry/ Engineering Physics Engineering Chemistry Lab/ Engineering Physics Lab	5		SOBST
			iv) Core-6 (Th4 C)	4	5	45	Introduction to Electrical and Electronics Engineering / Fundamentals of Mechanical and Mechatronics system	5		
			v) VAC-2 (Th4 C + P 1 C)	4 1	5 3	45 30	Fundamental Concepts and Problem Solving with Python Fundamental Concepts and Problem Solving with Python Lab	5		
			vi) SEC-1(P 2C)/ Lab-9	2	3	30	Introduction to CNC and 3-D Printer Lab / Introduction to Electrical and Electronics Engineering Lab	-		
			vii) Lab-10 (P 1 C)	1	3	30	Mechanical Workshop Lab / Engineering Graphics & Design Lab	-		SOBST
			viii) SEC-2 (P 2 C)	2	3	30	Advance Industrial training in 'C' Lab	-		
			ix) Audit Course	NC	-	-	Industrial Visit /Seminar on the report of visit	-		
			x) Audit Course	NC	-	-	University Social Responsibility - Community Outreach	-		
			xi)Lab 10 (SPT-PC-111)	2	3	30	Sports	5		
Program Outcome:PO1 - PO12 [ANNEXTURE-1]							**Program Specific Outcome:**PSO1 – PSO2 [ANNEXTURE-2]			
Note: 1. A total of 8 Credits are mandatory to earn from NPTEL/Moocs/Coursera during 4 years of B.Tech Program.										

Programme	Year	Semester (15 weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester)	Prerequisite	Elective (For other faculty)
BACHELOR OF TECHNOLOGY – COMPUTER SCIENCE & ENGINEERING	SECOND YEAR	SEMESTER –III	i) Core-7 (Th 4C)	4	5	45	Engineering Mathematics-III/ Engineering Science Electives**	5		SOBST
			ii) Core-8 (Th 4C + P 2C)	4 2	5 3	45 30	Operating System Operating System Lab	5		
			iii) Core-9 (Th 4C + P 2C)	4 2	5 3	45 30	Digital Logic System Digital Logic System Lab	5		
			iv) Core-10 (Th 4C + P 2C)	4 2	5 3	45 30	Theory of Computations Theory of Computations Lab	5		
			v) AECC-3 (P 2 C)	2	3	30	Advance Python Programming Lab	5		
			vi) SEC-3 (Th2C)	2	3	30	Computer Organization & Architecture	5		
			vii) Audit Course	NC	-	-	University Social Responsibility - Community Outreach			
			viii) Audit Course	NC	-	-	Sports	2		
		SEMESTER –IV	i) Core-11(Th.4C)	4	5	45	Engineering Science Electives**/ Engineering Mathematics-III	5		SOBST
			ii) Core-12 (Th.4 C + P. 2 C)	4 2	5 3	45 30	Java Programming Java Programming Lab	5		
			iii) Core-13 (Th.4 C + P. 2 C)	4 2	5 3	45 30	Data Structure using C Data Structure using C Lab	5		
			iv) VAC-3 (Th. 2 C)	2	3	30	1. Indian Ethos and Modern Management, 2. Ancient Sanskrit Language(CSU Delhi)	5		
			iv) DSE-1 (Th.4C)	4	5	45	1. OOPs 2. Data Analytics 3. Distributed System 4. Basics of IOT	5		
			v) GE-1 (Th. 4C)	4	5	45	Generic Elective-I**(To be opted from other school)**	5		
			vi) Lab-16 (P. 2C)	2	3	30	OOPs Lab with C++	5		

			vii) Audit Course	NC	-	-	Industrial Visit/Seminar/Presentation of the report of visit	-		
			viii) Audit Course	NC	-	-	University Social Responsibility - Community Outreach	-		
			ix) Lab 17	2	3	30	Sports	5		
Program Outcome:PO1 - PO12 [ANNEXTURE-1							**Program Specific Outcome:**PSO1 – PSO2 [ANNEXTURE-2]			
Note: Industrial Training of 4 Weeks/5Weeks to be completed between the semester break # Minor Certification Paper – I										

Programme	Year	Semester (15 weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester)	Prerequisite	Elective (For other faculty)
	THIRD YEAR (47 Cr.)	SEMESTER -V (24 Cr.)	i) C16 (Th. 4 Cr. +P 2 Cr.)	4 2	4 3	48 36	Design and Analysis of Algorithm Design and Analysis of Algorithm Lab	5		
			ii) SEC-4	2	3	36	Internship			
			iii) DSE-2	4	4	48	1. Machine Learning Techniques 2. Application of Soft Computing 3. Augmented & Virtual Reality 4. Human Computer Interface	5		
			i) C17 (Th. 4 Cr. +P 2 Cr.)	4 2	4 3	48 36	Discrete Structures & Theory of Logic Discrete Structures & Theory of Logic Lab	5		
			i) C18 (Th. 4 Cr. +P 2 Cr.)	4 2	4 3	48 36	Database Management System Database Management System Lab			
		SEMESTER – VI (23 Cr.)	i) C19 (Th. 4 Cr. + P 2Cr.)	4 2	4 3	48 36	Computer Networks Computer Networks Lab	5		
			ii) SEC-5(2 Cr.)	2	3	36	MOOCS (Swayam/ NPTEL)			
			iii) DSE-3(Th. 4 Cr.)	4	4	48	1.Big Data 2.Image Processing 3.Real Time Systems 4.Data Compression	5		
			i) C20 (Th. 4 Cr. + P 2 Cr.)	4 2	4 3	48 36	Compiler Design Compiler Design Lab	5		
			i) AECC-4 (Th. 3Cr)	3	3	36	Universal Human Values & Professional Ethics	5		
			ii) SEC-6(P 2 Cr)	2	3	36	Mini Project Lab			
PO1-PO12 (Annexure- 1)							**PSO1-PSO2 (Annexure-2)**			

Programme	Year	Semester (15 weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester)	Prerequisite	Elective (For other faculty)
	FOURTH YEAR (36 Cr.)	SEMESTER -VII (18 Cr.)	i) C21 (Th. 4Cr. + 2 Cr.) ii) SEC-7 (2 Cr.) iii)GE-2(4 Cr.)	4 2 2 4	4 3 2 4	48 36 24 48	Distributed Systems Distributed Systems Lab MOOCS (SWAYAM/NPTEL) ***#To be opted from another School***	5		
			i) SEC-8(2 Cr.)	2	3	36	Internship			
			i) Research Project (Industrial Training/ Internship Survey)	4	8	96	Minor Project			
		SEMESTER – VIII (18 Cr.)	i) GE-3 (Th. 4Cr) ii) DSE-4(Th. 4 Cr.) iii) Research Project (Industrial Training/ Internship Survey)	4 4 10	4 4 20	48 48 240	***#To be opted from another School*** 1. Mobile Computing 2. Internet of Things 3. Cloud Computing 4. Block chain Architecture Design Major Project	5		

***Major Project report will be evaluated by external & internal examiners & Research topic may be selected from the main core paper**
*** Industrial Training of 4 Weeks/5Weeks to be completed between the semester break**

PO1-PO12 (Annexure- 1) **(Annexure-2)**	**PSO1-PSO2**

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ANNEXTURE-1

Program Outcomes:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and Research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

ANNEXTURE-2

Program Specific Outcomes:

PSO1: Enabling students to learn continuously and to provide effective answers to new computational issues.

PSO2: Understand analyze data and create software to create computer-based systems of varying complexity that are designed effectively.

Format-3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Mathematical Thinking with Calculus and Linear Algebra**
Course Code: ENAS-111	**Title: Mathematical Thinking with Calculus and Linear Algebra**

Course Objectives:

1. To gain the knowledge of differential calculus required for the field of engineering.
2. To deal with functions of several variables that is essential in optimizing the results of real life problems.
3. To understand Multiple integral tools to deal with engineering problems involving Surface area, volume etc.
4. To deal with vector calculus that is required in different branches of Engineering to graduate engineers.
5. To understand the essential tools of matrices and linear algebra, Eigen values and diagonalization in a Comprehensive manner are required.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Differential Calculus:** Rolle's Theorem, Mean Value Theorems, Successive Differentiation (nth order derivatives), Leibnitz theorem, Taylor's and Maclaurin's Theorems (without proof), Expansion of functions (standard forms),	9L
II	**Partial Differentiation:** Functions of several variables, Limit, Continuity, Partial derivatives, Euler's Theorem, Total derivative, Chain rule, Jacobians, Taylor's expansion for multivariable functions, Maxima and Minima of functions of two variables.	9L
III	**Integral Calculus:** Multiple integration: Double integral, Triple integral, Change of order of integration, Change of variables, Application: Areas and volumes.	9L
IV	**Vector Calculus:** Vector differentiation: Gradient, Curl and Divergence and their Physical interpretation, Directional derivatives. Vector Integration: Line integral, Surface integral, Volume integral, Gauss's Divergence theorem, Green's theorem and Stoke's theorem (without proof) and their applications	9L

V	**Linear Algebra:** Types of Matrices: Symmetric, Skew-symmetric and Orthogonal Matrices; Complex Matrices, Inverse and Rank of matrix using elementary transformations, System of linear equations, Characteristic equation, Eigen values and eigenvectors, Cayley-Hamilton Theorem and its application, Diagonalization of a Matrix.	**9L**

Text Books:

1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*

Reference Books:

1. *E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.*
2. *Veerarajan T., Engineering Mathematics for first year, McGraw-Hill, New Delhi, 2008.*
3. *R K. Jain & S R K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House 2002*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	Understand the concept of differentiability and apply in the study of Successive differentiation, Leibnitz theorems and Partial differentiation.	**L2 & L3**
CO-2	Identify the application of partial differentiation and apply for evaluating maxima, minima, series and Jacobians.	**L3 &L4**
CO-3	Illustrate the working methods of multiple integral and apply for finding area, volume.	**L1& L3**
CO-4	Remember the concept of vector and apply for directional derivatives, tangent and normal planes. Also evaluate line, surface and volume integrals.	**L2 & L3**
CO-5	Remember the concept of matrices and apply for solving linear simultaneous equations.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	2	2	1	2	1	0	0	0	0	1	0
CO-3	2	2	0	1	1	0	0	0	0	0	0	2
CO-4	3	0	2	1	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I / II**
Credits: 4 **Theory: 4** **Practical: 2**	**Subject: Modern Physics in Engineering**
Course Code: ENAS-112/ENAS-122	**Title: Modern Physics in Engineering**

Course Objectives:

1. To know the concept of Interference and Diffraction.
2. To know the significance of Maxwell's equations in the Engineering applications of electromagnetic waves.
3. Explain Quantum Mechanics to understand wave particle dualism. Necessity of quantum mechanics to explore.
4. To understand the concept of Relativistic Mechanics.
5. To understand the Phenomenon of Fiber optics and Laser.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)
50% Marks / 2 Credits

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Wave Optics:** Interference: Basics of interference of light, coherent Sources, Conditions of Interference; Interference by division of wave front and amplitude (Interference due to thin film, Wedge shaped film and Newton's Rings). **Diffraction:** Fraunh offer Diffraction Due Single slit, Diffraction Grating; Diffraction due to N slits, Rayleigh's criterion of resolution; absent spectra, dispersive Power of grating, Resolving power of Grating.	**12L**
II	**Electromagnetic:** Gauss law Ampere's law and displacement current; Equation of continuity; Maxwell's equations in Integral and Differential Forms; Electromagnetic Wave Propagation in Free Space and Conducting Media; Poynting Theorem	**9L**
III	**Quantum Mechanics:** Planck's concept (hypothesis), Compton Effect, Particle properties of wave: Matter Waves, Davisson Germer Experiment, Heisenberg Uncertainty Principle, Wave function, and Schrodinger equation (time dependent & independent), Particle in a 1-D box.	**9L**
IV	**Relativistic Mechanics:** Inertial and Non- Inertial Frames; Michelson-Morley Experiment; Postulates of Special Theory of Relativity; Galilean and Lorentz Transformation; Length Contraction and Time Dilation;	**9L**

	Addition of Velocities; Mass Energy Equivalence and Variation of Mass with Velocity.	
V	**Laser:** Absorption of radiation, Spontaneous and stimulated emission of radiation, Population inversion, Einstein's Coefficients, Principles of laser action, Components of laser, Solid state Laser (Ruby laser) and Gas Laser (He-Ne laser), Laser applications	**6L**

Text Books:
1. Concepts of Modern Physics – Aurthur Beiser (Mc-Graw Hill)
2. Introduction to Special Theory of Relativity- Robert Resnick (Wiley)
3. Engineering Physics: Theory and Practical- Katiyar and Pandey (Wiley India)

Reference Books:
1. *Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New)*
2. *Engineering Physics-Malik HK and Singh AK (McGrawHill)*

If the course is available as **Generic Elective**, then the students of following departments may opt it: NO

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Physics of Class 12

Course Learning Outcomes:

CO-1	Apply the principles of wave optics to analyze and predict light behavior in various scenarios.	**L3 & L4**
CO-2	Analyze and solve problems involving electromagnetic fields and waves in various contexts.	**L4**
CO-3	Remember and apply the principles of quantum mechanics to understand and predict the behavior of particles at the atomic and subatomic levels.	**L1 & L3**
CO-4	Understand the principles of relativistic mechanics to analyze and predict the behavior of objects moving at velocities close to the speed of light.	**L2 & L4**
CO-5	Understand and apply the principles of laser technology.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B. Tech. ME**	**Year: I** **Semester: I/II**
Credits: 4 **Theory: 4** **Practical: 0**	**SUBJECT: ENGINEERING CHEMISTRY**
Course Code: ENAS-113/ ENAS-123	**Title: ENGINEERING CHEMISTRY**

Course Objectives:

1. To enable the students to understand about the Chemistry of Atomic and Molecular structure, Chemistry of advanced Materials like Liquid crystals, Nanomaterials, Graphite & fullerenes, and Green Chemistry.
2. To enable the students to understand and apply the detailed concepts of spectroscopic techniques and stereochemistry to identify the compounds, element etc.
3. To enable the students to understand and apply the concepts related to Electrochemistry, Batteries, Corrosion and Chemistry of Engineering Materials like cement.
4. To enable the students to understand and apply detailed concepts of water source, water impurities, hardness of water and boiler troubles used in industry as well as analysis of coal & determination of calorific values.
5. To enable the students to understand detailed concepts related to polymers, Polymerization, Polymer Blends, Polymer Composites, and organometallic compounds.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Atomic and Molecular Structure:** Molecular orbitals of diatomic molecules (bond order, magnetic characters and numerical problems). **Chemistry of Advanced Materials:** ***Liquid Crystals;*** Introduction, Types and Applications of liquid crystals, industrially important materials used as liquid crystals. ***Graphite and Fullerene;*** Introduction, Structure and applications. ***Nanomaterials;*** Introduction, Preparation, characteristics of nanomaterials and applications of nanomaterials: Carbon Nano Tubes (CNT) and graphene. **Green Chemistry:** Introduction to green chemistry, 12 principles and importance of green Synthesis, Green Chemicals, Synthesis of typical organic compounds by conventional and Green routes (Adipic acid and Paracetamol), Environmental impact of Green chemistry on society.	**10L**
II	**Spectroscopic techniques and Applications:** Elementary idea and simple applications of Ultraviolet (UV) & Visible, fluorescence, Jablonski diagram, IR and Raman spectroscopy.	**8L**

	Stereochemistry: Optical isomerism in compounds without chiral carbon, Geometrical isomerism, Chiral Drugs.	
III	**Electrochemistry:** Nernst Equation and application, relation of EMF with thermodynamic functions (ΔH, ΔF and Δ S). Lead storage battery. **Corrosion**; causes, effects and its prevention. **Chemistry of Engineering Materials:** ***Cement;*** Constituents, manufacturing, hardening and setting, deterioration of cement, Plaster of Paris (POP).	**9L**
IV	**Water Analysis:** Hardness of water, Techniques for water softening (Lime-soda, Zeolite, Ion exchange resin and Reverse osmosis method). **Fuels:** classification of fuels, Analysis of coal, Determination of calorific value (Bomb calorimeter and Dulon's method).	**8L**
V	**Polymers:** Basic concepts of Polymer-Blend and composites, Conducting and biodegradable polymers. Preparation and application of some industrially important polymers (Buna-S, Buna-N, Neoprene, Nylon-6, nylon-6,6, Teflon, Lucite, Bakelite, and Terylene). **Organometallic Compounds:** General methods of synthesis of organometallic compounds (Grignard reagent and lithium aluminum hydride) and their applications.	**9L**

Reference Books:

1. Engineering Chemistry by Rath & Singh, 2nd Edition, Cengage Learning India Pvt. Ltd Delhi.
2. Engineering Chemistry by SS Dara, S Chand & Co Ltd
3. Engineering Chemistry by Jain & Jain, S. Chand & Comp, New Delhi
4. Engineering Chemistry by K. Sesha Maheswaramma, Pearson
5. Engineering Chemistry by OG Palanna, Mc Graw Hill Education, New Delhi
6. Engineering Chemistry by Shashi Chawala, Dhanpat Rai Publishing Comp, New Delhi

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NA**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: NA

Course Learning Outcomes: After completion of the course, the student should be able to:

CO-1	Understand about the principles of atomic and molecular structure, bonding and properties, chemistry of advanced materials like Liquid Crystals, Nanomaterials, Graphite, graphene & Fullerenes as well as the principles of green chemistry.	**L1 & L2**
CO-2	Apply the fundamental concepts of determination of structure with various spectral techniques and stereochemistry	**L2 & L3**

CO-3	Apply the theory of construction of electrodes, batteries and fuel cells and re-designing or new engineering products, and categorize the reasons for corrosion and study methods to control corrosion, and develop an understanding of the chemistry of cement.	**L3 & L2**
CO-4	Understand the sources, impurities and hardness of water, apply the concepts of determination of calorific values and analyze the coal.	**L2, L3 & L4**
CO-5	Understand the chemical structure of polymers and its effect on their various properties when used as engineering materials. Understanding the applications of specific polymers and organometallic compounds, applicable in industrial process.	**L1 & L2**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	3	2	2	2	2	0	0	0	0	2
CO-2	2	3	2	3	3	1	1	0	0	0	0	2
CO-3	3	3	3	3	2	2	2	0	1	0	0	1
CO-4	3	3	3	2	2	2	2	0	0	0	0	1
CO-5	3	3	2	2	2	2	2	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**SUBJECT: FUNDAMENTALS OF MECHANICAL AND MECHATRONICS SYSTEMS**
Course Code: ENME-111N	**TITLE: FUNDAMENTALS OF MECHANICAL AND MECHATRONICS SYSTEMS**

Course Objectives:

1. Introduce fundamental principles and theories in Mechanical Engineering.
2. Provide an overview of the historical development and current trends in Mechanical Engineering.
3. Familiarize students with basic engineering concepts such as forces, materials, structures, and systems relevant to both disciplines.
4. Develop problem-solving skills through practical applications and case studies in Mechanical Engineering contexts.
5. Cultivate an understanding of the interdisciplinary nature of Engineering and its impact on society and the environment.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Materials:** Classification of engineering material, Composition of Cast iron and Carbon steels, Iron Carbon diagram. Mechanical properties like strength, hardness, toughness, ductility, brittleness, malleability etc. of materials. Hooks law and modulus of elasticity, Hardness and Impact testing of materials, BHN etc.	9L
II	**Force Systems**: Basic concepts: Definitions, Basic assumptions, Scalar & Vector quantities, Classification of forces & Representation, Force as a Vector, Composition of forces, Parallelogram Law, Resolution, Principle of Transmissibility of forces **Coplanar Concurrent Force system and Coplanar:** Equilibrium of coplanar force system, Free body diagrams, Determination of reactions, Equilibrium of a body under three forces, Lami's theorem.	9L
III	**Introduction to mechanics of solid:** Normal and shear Stress, strain, Hookes' law, Poisson's ratio, elastic	9L

	constants and their relationship, stress-strain diagram for ductile and brittle materials, factor of safety. Basic Numerical problems. Types of beams under various loads.	
IV	**Thermodynamics:** Thermodynamic system, properties, state, process, Zeroth, First and second law of thermodynamics, thermodynamic processes at constant pressure, volume, enthalpy & entropy. Steam Engineering: Classification and working of boilers, mountings and accessories of boilers, Efficiency.	**9L**
V	**Fundamental of Mechatronics:** Definition of Mechatronics, Sensors and Transducers: Definition, difference, classification, Actuators: Definition and Classification of Actuators Need and Scope, Programmable Logic Controller (PLC): Definition, PLC block diagram, Microcontroller: Comparison of Microprocessor and Microcontroller	**9L**

Text Books:
1. Nag P.K, Engineering Thermodynamics, TMH.
2. Agrawal C M, Basic Mechanical Engineering, Wiley Publication.

Reference Books:
1. Nag P.K, Engineering Thermodynamics, TMH.
2. Achuthan M, Engineering Thermodynamics, PHI. List of Suggestive
3. Ganesan, Internal Combustion Engines, TMH.
4. Textbook Of Mechatronics. R K Rajput

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand mechanical properties such as strength, hardness, toughness, ductility, brittleness, and malleability.	**L2 & L3**
CO-2	Understand the working principles of Lamis theorem	**L3 &L4**
CO-3	Understand steam engineering principles including boiler classification, mountings, accessories, and efficiency.	**L1& L3**
CO-4	Understand the concepts and purposes of various forces.	**L2 & L3**
CO-5	Understand about the basics of Mechatronics.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Structured Programming and Problem Solving in C**
Course Code: ENCS-111	**Title: Structured Programming and Problem Solving in C**

Course Objectives:

1. To understand the basics of computers, programming languages, the history and structure of the C language, and its compilation and execution process.
2. To learn to define problems, analyze them, and create solutions using algorithms, flowcharts, and pseudo code.
3. To gain proficiency in data types, variables, constants, literals, operators, expressions, and input/output functions in C.
4. To apply conditional statements, switch-case statements, looping structures, and functions, including recursion and library functions, in C programs.
5. To Work with arrays, strings, pointers, structures, unions, file handling, preprocessor directives, and advanced data structures, and solve real-world problems through case studies and project-based learning.

Nature of Paper: VAC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION TO PROGRAMMING AND PROBLEM SOLVING:** **INTRODUCTION TO COMPUTERS AND PROGRAMMING:** Overview of computers and programming languages, History and evolution of C language, Basic structure of a C program, Compilation and execution process. **PROBLEM SOLVING TECHNIQUES:** Problem definition and analysis, Algorithms and flowcharts, Pseudocode **FUNDAMENTALS OF C:** Data types and variables, Constants and literals, Operators and expressions, Input and output functions.	**9L**
II	**CONTROL STRUCTURES AND FUNCTIONS:** **CONTROL STRUCTURES:** Conditional statements (if, if-else, nested if), Switch-case statements, looping structures (for, while, do-while), Break and continue statements, **FUNCTIONS:** Function declaration and definition, Function calling and	**9L**

	parameter passing, Scope and lifetime of variables, Recursive functions, Library functions.	
III	**ARRAYS, STRINGS, AND POINTERS:** **ARRAYS:** One-dimensional arrays, Two-dimensional arrays, Multidimensional arrays, Array operations and applications, **STRINGS:** String handling functions, String manipulation techniques. **POINTERS:** Introduction to pointers, Pointer arithmetic, Pointers and arrays, Pointers to functions, Dynamic memory allocation.	**9L**
IV	**STRUCTURES, UNIONS, AND FILE HANDLING:** **STRUCTURES AND UNIONS:** Defining and declaring structures, Accessing structure members, Array of structures, Nested structures, Unions and their applications. **FILE HANDLING:** File operations (opening, closing, reading and writing), File modes, Sequential and random access files, Error handling in file operations.	**9L**
V	**ADVANCED TOPICS AND CASE STUDIES:** **PREPROCESSOR DIRECTIVES:** Macros, File inclusion, Conditional compilation. **ADVANCED DATA STRUCTURES:** Introduction to linked lists, Stacks and queues (concepts and basic operations). **PROBLEM SOLVING CASE STUDIES:** Real-world problem solving using C, Case studies and project-based learning, Debugging and testing techniques, Best practices in programming.	**9L**

Text Books:

1. *Computer Programming with C, Special Edition-MRCET, Mc Graw Hill Publishers 2017,*
2. *Computer Science: A Structured Programming Approach Using C, B, A, Forouzan and R, F, Gilberg, Third Edition, Cengage Learning,*

Reference Books:

1. *The C Programming Language, B, W, Kernighan and Dennis M, Ritchie, PHI*
2. *Computer Programming, E, Balagurusamy, First Edition, TMH*
3. *C and Data structures – P, Padmanabham, Third Edition, B, S, Publications,*

If the course is available as **Generic Elective**, then the students of following departments may opt it: NO

Evaluation/Assessment Methodology	
Category	**Max, Marks**
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Students will demonstrate an understanding of the fundamentals of computers,	**L2 & L3**

	and evolution of the C programming language, the basic structure of a C program, and the compilation and execution processes.	
CO-2	Students will be able to define and analyze programming problems, develop algorithms, create flowcharts, and write pseudo code to design effective solutions.	**L1,L2& L3**
CO-3	Students will gain proficiency in fundamentals of C and will be able to implement basic input and output functions.	**L1,L2& L3**
CO-4	Students will be able to apply conditional statements, switch-case statements, and looping structures to control program flow, and will understand function declaration, definition, calling, parameter passing, scope, lifetime of variables, and recursion.	**L2,L3 & L4**
CO-5	Students will demonstrate the ability to work with arrays, strings, and pointers, define and utilize structures and unions, perform file operations, and understand advanced data structures like linked lists, stacks, and queues. They will also be able to solve real-world problems using C.	**L2,L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	3	1	2	2	1	0	0	0	1	2	3
CO-2	3	2	3	2	1	1	0	0	0	1	1	1
CO-3	3	2	2	2	1	0	0	0	0	0	1	3
CO-4	2	3	3	2	2	1	0	0	0	1	2	2
CO-5	1	3	2	3	2	1	0	0	0	0	1	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I/II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Professional Communication and Digital fluency**
Course Code: ENAS-114/ ENAS-124	**Title: Professional Communication and Digital fluency**

Course Objectives:

1. To understand and apply basic principles of professional communication, including the communication process and overcoming barriers.
2. To enhance the essentials of technical writing for engineering, including reports, documentation, professional emails, and proposals.
3. To gain confidence in public speaking, create effective presentations, and learn to engage different audiences.
4. To develop skills for building rapport, effective teamwork, conflict resolution, and leadership communication.
5. To learn to effectively use digital communication tools, social media, and adapt to emerging trends in global engineering contexts.

Nature of Paper: AECC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Fundamentals of Communication:** Definition and importance, Communication process, Verbal and non-verbal communication, Barriers to communication, Formal and informal communication.	9L
II	**Professional Speaking and Presentation Skills:** Public speaking, Group discussion, Effective oral communication, Use of visual aids, Body language, Elevator pitch, Presentation planning and delivery.	9L
III	**Business and Technical Writing:** Email etiquette, Resume and cover letter writing, Report writing, Technical documentation, Memos, Minutes of meetings.	9L
IV	**Digital Literacy and Collaboration Tools:** Digital platforms for communication (Zoom,Teams, Slack), Cloud collaboration (Google Docs, OneDrive), Etiquette of digital communication, Netiquette, Cyber safety.	9L
V	**Professionalism and Work Ethics:** Workplace behavior, Teamwork, Leadership communication, Conflict resolution, Time management, Building online presence through LinkedIn and digital portfolios.	9L

Text Books and Reference Books:

1. *"Technical Communication: A Practical Approach" by William Sanborn Pfeiffer and Kaye E. Adkins*
2. *"The Essentials of Technical Communication" by Elizabeth Tebeaux and Sam Dragga*
3. *"Engineering Communication" by Charles W. Knisely and Karin I. Knisely*
4. *"Communicating in Groups: Applications and Skills" by Katherine Adams, Gloria Galanes, and Brandi R. Fritz*
5. *"Digital Communications: Fundamentals and Applications" by Bernard Sklar*

If the course is available as **Generic Elective**, then the students of following departments may opt it: NO

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations/Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: English of Class 12

Course Learning Outcomes:

CO-1	Demonstrate effective communication skills, including verbal, non-verbal, and written, in professional engineering contexts.	**L2 & L3**
CO-2	Develop clear, concise, and coherent technical documents, including reports, project documentation, and professional emails.	**L3 &L4**
CO-3	Deliver engaging and informative oral presentations tailored to diverse audiences, utilizing effective visual aids and presentation techniques.	**L1& L3**
CO-4	Exhibit strong interpersonal and teamwork skills, including active listening, conflict resolution, and leadership communication.	**L2 & L3**
CO-5	Utilize digital communication tools and social media platforms to enhance professional networking and collaboration, adapting to emerging communication trends and global engineering contexts.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I/II**
Credits: 5 **Theory: 4** **Practical: 1**	**SUBJECT: ENVIRONMENT, ECOLOGY AND SUSTAINIBILITY**
Course Code: ENHU-112/ ENHU-122P	**TITLE: ENVIRONMENT, ECOLOGY AND SUSTAINIBILITY**

Course Objectives:

1. To introduce students to the interrelationship between humans and the environment, tracing historical, cultural, and ethical dimensions of sustainability.
2. To equip students with knowledge about natural resources, biodiversity, ecosystems, and their conservation strategies.
3. To raise awareness of major environmental issues local to global—such as pollution, climate change, land degradation, and disaster risk.
4. To familiarize students with environmental laws, policies, and international treaties related to environmental governance and sustainable development.
5. To encourage experiential learning through field visits, case studies, and hands-on campus environmental management activities.

Nature of Paper: AECC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)
50% Marks / 1 Credits

L : 3	T : 1	P : 3	C : 4+1

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Humans and the Environment:** The man-environment interaction: Humans as hunter-gatherers; Mastery of fire; Origin of agriculture; Emergence of city-states; Great ancient civilizations and the environment, Indic Knowledge and Culture of sustainability; Middle Ages and Renaissance; Industrial revolution and its impact on the environment; Population growth and natural resource exploitation; Global environmental change. **Environmental Ethics and emergence of environmental ism**: Anthropocentric and eco-centric perspectives (Major thinkers); The Club of Rome- Limits to Growth; UN Conference on Human Environment 1972; World Commission on Environment and Development and the concept of sustainable development; Rio Summit and subsequent international efforts.	9L
II	**Natural Resources and Sustainable Development**: Overview of natural resources: Definition of resource; Classification of natural resources- biotic and abiotic, renewable and non-renewable. **Biotic resources**: Major type of biotic resources- forests, grasslands,	9L

	wetlands, wildlife and aquatic (fresh water and marine); Microbes as a resource; Status and challenges. **Water resources**: Types of water resources- fresh water and marine resources; Availability and use of water resources; Environmental impact of over-exploitation, issues and challenges; Water scarcity and stress; Conflicts over water. **Soil and mineral resources**: Important minerals; Mineral exploitation; Environmental problems due to extraction of minerals and use; Soil as a resource and its degradation. **Energy resources**: Sources of energy and their classification, renewable and non-renewable sources of energy; Conventional energy sources- coal, oil, natural gas, nuclear energy; Non-conventional energy sources- solar, wind, tidal, hydro, wave, ocean thermal, geothermal, biomass, hydrogen and fuel cells; Implications of energy use on the environment. **Introduction to sustainable development**: Sustainable Development Goals (SDGs) - targets and indicators, challenges and strategies for SDGs.	
III	**Environmental Issues: Local, Regional and Global:** **Environmental issues and scales**: Concepts of micro-, meso-, synoptic and planetary scales; Temporal and spatial extents of local, regional, and global phenomena. **Pollution**: Impact of sectoral processes on Environment; Types of Pollution- air, noise, water, soil, thermal, radioactive; municipal solid waste, hazardous waste; transboundary air pollution; acid rain; smog. Land use and Land cover change: land degradation, deforestation, desertification, urbanization. Biodiversity loss: past and current trends, impact. **Global change**: Ozone layer depletion; Climate change. Disasters – Natural and Man-made	**9L**
IV	**Conservation of Biodiversity and Ecosystems:** Biodiversity and its distribution: Biodiversity as a natural resource; Levels and types of biodiversity; Biodiversity in India and the world; Biodiversity hotspots; Species and ecosystem threat categories. **Ecosystems and ecosystem services**: Major ecosystem types in India and their basic characteristics- forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services- classification and their significance. Threats to biodiversity and ecosystems: Land use and land cover change; Commercial exploitation of species; Invasive species; Fire, disasters and climate change. **Major conservation policies**: in-situ and ex-situ conservation approaches; Major protected areas; National and International Instruments for biodiversity conservation; the role of traditional knowledge, community-based conservation; Gender and conservation.	**9L**
V	**Environmental Pollution and Health: Understanding pollution: Production processes and generation of wastes; Assimilative capacity of the environment; Definition of pollution; Point sources and non-point sources of pollution.** **Air pollution: Sources of air pollution; Primary and secondary pollutants; Criteria pollutants- carbon monoxide, lead, nitrogen oxides, ground-level ozone, particulate matter and sulphur dioxide;**	**9L**

	Other important air pollutants- Volatile Organic compounds (VOCs), Peroxyacetyl Nitrate (PAN), Polycyclic aromatic hydrocarbons (PAHs) and Persistent organic pollutants (POPs); Indoor air pollution; Adverse health impacts of air pollutants; National Ambient Air Quality Standards. Water pollution: Sources of water pollution; River, lake and marine pollution, groundwater pollution; water quality Water quality parameters and standards; adverse health impacts of water pollution on human and aquatic life. **Soil pollution and solid waste: Soil pollutants and their sources; Solid and hazardous waste; Impact on human health.** **Noise pollution: Definition of noise; Unit of measurement of noise pollution; Sources of noise pollution; Noise standards; adverse impacts of noise on human health.** Thermal and Radioactive pollution: Sources and impact on human health and ecosystems.	
VI	**Climate Change: Impacts, Adaptation and Mitigation: Understanding climate change: Natural variations in climate; Structure of atmosphere; Anthropogenic climate change from greenhouse gas emissions– past, present and future; Projections of global climate change with special reference to temperature, rainfall, climate variability and extreme events; Importance of 1.5 °C and 2.0 °C limits to global warming; Climate change projections for the Indian sub-continent.** **Impacts, vulnerability and adaptation to climate change: Observed impacts of climate change on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests and natural ecosystems; Impacts on animal species, agriculture, health, urban infrastructure; the concept of vulnerability and its assessment; Adaptation vs. resilience; Climate-resilient development; Indigenous knowledge for adaptation to climate change.** **Mitigation of climate change**: Synergies between adaptation and mitigation measures; Green House Gas (GHG) reduction vs. sink enhancement; Concept of carbon intensity, energy intensity and carbon neutrality; National and international policy instruments for mitigation, decarbonizing pathways and net zero targets for the future; Energy efficiency measures; Renewable energy sources; Carbon capture and storage, National climate action plan and Intended Nationally Determined Contributions (INDCs); Climate justice.	**9L**

VII	**Environmental Management: Introduction to environmental laws and regulation: Constitutional provisions- Article 48A, Article 51A (g) and other derived environmental rights; Introduction to environmental legislations on the forest, wildlife and pollution control.** **Environmental management system: ISO 14001 Concept of Circular Economy, Life cycle analysis; Cost-benefit analysis Environmental audit and impact assessment; Environmental risk assessment Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability; Ecolabeling/Ecomark scheme**	**9L**
VIII	**Environmental Treaties and Legislation**: An overview of instruments of international cooperation; bilateral and multilateral agreements; conventions and protocols; adoption, signature, ratification and entry into force; binding and non- binding measures; Conference of the Parties (COP) **Major International Environmental Agreements**: Convention on Biological Diversity (CBD); Cartagena Protocol on Biosafety; Nagoya Protocol on Access and Benefit-sharing; **Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES);** Ramsar Convention on Wetlands of International Importance; United Nations Convention to Combat Desertification (UNCCD); Vienna Convention for the Protection of the Ozone Layer; Montreal Protocol on Substances that Deplete the Ozone Layer and the Kigali Amendment; Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal; Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade; Stockholm Convention on Persistent Organic Pollutants; Minamata Convention on Mercury; United Nations Framework Convention on Climate Change (UNFCCC); Kyoto Protocol; Paris Agreement; India's status as a party to major conventions **Major Indian Environmental Legislations**: The Wild Life (Protection) Act, 1972; The Water (Prevention and Control of Pollution) Act, 1974; The Forest (Conservation) Act, 1980; The Air (Prevention and Control of Pollution) Act, 1981; The Environment (Protection) Act, 1986; The Biological Diversity Act, 2002; The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006; Noise Pollution (Regulation and Control) Rules, 2000; Industry-specific environmental standards; Waste management rules; Ramsar sites; Biosphere reserves; Protected Areas; Ecologically Sensitive Areas; Coastal Regulation Zone; Status phase-out of production and consumption of Ozone Depleting Substances by India; National Green Tribunal; Some landmark Supreme Court judgements **Major International organizations and initiatives**: United Nations Environment Programme (UNEP), International Union for Conservation of Nature (IUCN), World Commission on Environment and Development (WCED), United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Panel on Climate Change (IPCC), and Man and the Biosphere (MAB) programme.	**9L**

IX	**Case Studies and Field Work**: The students are expected to be engaged in some of the following or similar identified activities: 1. Discussion on one national and one international case study related to the environment and sustainable development. 2. Field visits to identify local/regional environmental issues, make observations including data collection and prepa re a brief report. 3. Participation in plantation drive and nature camps. 4. Documentation of campus biodiversity. Campus environmental management activities such as solid waste disposal, water Management and sanitation, and sewage treatment.	**9L**

Reference Books: Reference Books:

1. Fisher, Michael H. (2018) An Environmental History of India- From Earliest Times to the Twenty-First Century, Cambridge University Press.
2. Hedrick, Daniel R. (2020) Humans versus Nature- A Global Environmental History, Oxford University Press.
3. Hughes, J. Donald (2009) An Environmental History of the World- Humankind's Changing Role in the Community of Life, 2nd Edition. Routledge.
4. Perman, R., Ma, Y., McGillivray, J., and Common, M. (2003) Natural Resource and Environmental Economics. Pearson Education.
5. Simmons, I. G. (2008). Global Environmental History: 10,000 BC to AD 2000. Edinburgh University Press
6. Chiras, D. D and Reganold, J. P. (2010). Natural Resource Conservation: Management for a Sustainable Future.10th edition, Upper Saddle River, N. J. Benjamin/Cummins/Pearson.
7. John W. Twidell and Anthony D. (2015). Renewable Energy Sources, 3rd Edition, Weir Publisher (ELBS)
8. William P.Cunningham and Mary A. (2015) Cunningham Environmental Science: A Global Concern, Publisher (Mc-Graw Hill, USA)
9. Gilbert M. Masters and W. P. (2008). An Introduction to Environmental Engineering and Science, Ela Publisher (Pearson)
10. Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications https://sdgs.un.org/goals
11. Harper, Charles L. (2017) Environment and Society, Human Perspectives on Environmental Issues 6th Edition. Routledge.
12. Harris, Frances (2012) Global Environmental Issues, 2nd Edition. Wiley- Blackwell.
13. William P. Cunningham and Mary A. (2015). Cunningham Environmental Science: A global concern, Publisher (Mc-Graw Hill, USA)
14. Manahan, S.E. (2022). Environmental Chemistry (11^{th} ed.). CRC Press. https://doi.org/10.1201/9781003096238
15. Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press.
16. Bawa, K.S., Oomen, M.A. and Primack, R. (2011) Conservation Biology: A Primer for South Asia. Universities Press.
17. Sinha, N. (2020) Wild and Wilful. Harper Collins, India.
18. Varghese, Anita, Oommen, Meera Anna, Paul, Mridula Mary, Nath, Snehlata (Editors) (2022) Conservation through Sustainable Use: Lessons from India. Routledge.
19. Bhagwat, Shonil (Editor) (2018) Conservation and Development in India: Reimagining Wilderness, Earthscan Conservation and Development, Routledge.
20. Krishnamurthy, K.V. (2003) Textbook of Biodiversity, Science Publishers, Plymouth, UK

21. Jackson, A. R., & Jackson, J. M. (2000). Environmental Science: The Natural Environment and Human Impact. Pearson Education.
22. Masters, G. M., & Ela, W. P. (2008). *Introduction to environmental engineering and science* (No. 60457). Englewood Cliffs, NJ: Prentice Hall.
23. Miller, G. T., & Spoolman, S. (2015) Environmental Science. Cengage Learning.
24. Central Pollution Control Board Web page for various pollution standards. https://cpcb.nic.in/standards/
25. Ahluwalia, V. K. (2015). *Environmental Pollution, and Health*. The Energy and Resources Institute (TERI).
26. Pittock, Barrie (2009) Climate Change: The Science, Impacts and Solutions. 2nd Edition. Routledge.
27. www.ipcc.org; https://www.ipcc.ch/report/sixth-assessment-report-cycle/.
28. Adenle A., Azadi H., Arbiol J. (2015). Global assessment of technological innovation for climate change adaptation and mitigation in developing world, Journal of Environmental Management, 161 (15): 261-275.
29. Barnett, J. & S. O'Neill (2010). Maladaptation. Global Environmental Change—Human and Policy Dimensions 20: 211–213.
30. Berrang-Ford, L., J.D. Ford & J. Paterson (2011). Are we adapting to climate change? Global Environmental Change—Human and Policy Dimensions 21: 25-33.
31. Jørgensen, Sven Marques, Erik João Carlos and Nielsen, Søren Nors (2016) Integrated Environmental Management, A trans disciplinary Approach. CRC Press.
32. Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.
33. Barrow, C. J. (1999). Environmental management: Principles and practice. Routledge.
34. Tiefenbacher, J (ed.) (2022), Environmental Management - Pollution, Habitat, Ecology, and Sustainability, Intech Open, London. 10.5772/
35. Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.
36. UNEP (2007) Multilateral Environmental Agreement Negotiator's Handbook, University of Joensuu, ISBN 978-952-458-992-5
37. Ministry of Environment, Forest and Climate Change (2019) A Handbook on International Environment Conventions & Programmes. https://moef.gov.in/wp- content/uploads/2020/02/convention-V-16-CURVE-web.pdf
38. Kanchi Kohli and Manju Menon (2021) Development of Environment Laws in India, Cambridge University Press.
39. India Code – Digital repository of all Central and State Acts: https://www.indiacode.nic.in/Bohra, Saroj, Judicial Intervention and Evolution of Environmental Principles and Doctrines (January 7, 2019). Available at SSRN: https://ssrn.com/abstract=3311406 or http://dx.doi.org/10.2139/ssrn.3311406

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology	
Category	**Max. Marks**
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA

5) ESE	100
Total:	**150**

Course Learning Outcomes:

CO1	Explain the evolution of human-environment interaction, environmental ethics, and sustainability principles.	L2
CO2	Classify natural resources and evaluate their usage, challenges, and conservation strategies.	L3
CO3	Analyze local, regional, and global environmental issues, including pollution, biodiversity loss, and land use change.	L4
CO4	Interpret the causes, consequences, and mitigation strategies of climate change and global environmental change.	L3
CO5	Describe key environmental policies, laws, and treaties at national and international levels.	L2

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO1	2	1	1	1	1	2	3	2	1	2	0	2
CO2	2	2	2	2	1	2	3	2	0	1	0	3
CO3	1	2	2	2	1	3	3	2	1	2	0	3
CO4	2	2	2	2	2	3	3	2	1	2	0	3
CO5	2	1	1	1	1	3	3	3	0	2	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I/II**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: MODERN PHYSICS IN ENGINEERING LAB**
Course Code: ENAS-112P/ ENAS-122P	**Title: MODERN PHYSICS IN ENGINEERING LAB**

Course Objectives:
1. To understand the concept of wave length by the interference
2. To understand the concept of wave length by the diffraction.
3. To understand the concept of viscosity of liquid and flow of liquid
4. To understand the energy band gap in the semiconductors
5. To understand the concept of polarization

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	To determine the wavelength of Sodium light by Newton's rings
Practical-2.	To determine the wavelength of prominent lines of mercury by plane diffraction grating
Practical-3.	To determine the focus length combination of two lenses separated by distance and verify the formula for the focal length of combination of lenses
Practical-4.	To determine the wave length of sodium light with the help of Fresnel's bi-prism
Practical-5.	To determine the coefficient of viscosity of a given liquid
Practical-6.	To verify Stefan's law
Practical-7.	Calibration of a volt meter with potentiometer
Practical-8.	To determine the resistance per unit length and specific resistance of a given resistance using Carey Foster 's Bridge
Practical-9.	To determine the energy bend gap of a given semiconductor material
Practical-10.	To determine the Specific Rotation of the Cane sugar solution with the help of Polarimeter

Reference/Text Books:
1. *Practical Physics- K. K. Dey & B. N. Dutta (Kalyani Publishers New Delhi)*
2. *Engineering Physics- Practical- Katiyar & Pandey (Wiley India)*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce (External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	To determine the wavelength of sodium light by Newton's ring experiment	**L3**
CO-2	To determine the wavelength of sodium light with the help of Fresnel's bi-prism	**L3**
CO-3	To determine the viscosity of liquid.	**L3**
CO-4	To determine the emission of energy with respect the temperature and verify Stefan's law.	**L3 & L4**
CO-5	To determine the calibration of potential and draw the curve.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	2	0	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	2	2	1	0	0	0	0	0	0	2	2
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I/II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: Engineering Chemistry Lab**
Course Code: ENAS-113P/ ENAS-123P	**Title: Engineering Chemistry Lab**

Course Objectives:
1. Student will be able to Estimate different impurities present in water sample.
2. Student will be able to Determine molecular properties such as surface tension, viscosity, pH, conductance and concentration of solution.
3. Student will be able to Identify iron concentration and percentage of available chlorine in supplied sample using titration methods

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	To determine total alkalinity in the given water sample.
Practical-2.	To determine the temporary and permanent hardness in water sample using EDTA as standard solution.
Practical-3.	To determine the available chlorine in bleaching powder solution.
Practical-4.	To determine the chloride content in the given water sample by Mohr's method.
Practical-5.	To determine the pH of the given solution using pH meter and pH-metric titration.
Practical-6.	To determine the Equivalent weight of Iron by the chemical displacement method.
Practical-7.	To determine the Viscosity of an addition polymer like polyester by Viscometer.
Practical-8.	To find chemical oxygen demand of waste water sample by potassium dichromate
Practical-9.	To determine the iron content in the given sample using external indicator
Practical-10.	To determine the strength of given HCL solution by titrating against N/10 Standard Sodium hydroxide solution

Reference/Text Books:
1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks

1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce (External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Estimate different impurities present in water sample.	**L4**
CO-2	Determine molecular properties such as surface tension, viscosity, pH, conductance and concentration of solution	**L3**
CO-3	Identify iron concentration and percentage of available chlorine in supplied sample using titration methods.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	0	2	1	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	3	3	1	0	0	0	0	0	0	2	1
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I/II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: PROGRAMMING WITH C LAB: HANDS ON LOGIC BUILDING**
Course Code: ENCS-111P	**Title: PROGRAMMING WITH C LAB: HANDS ON LOGIC BUILDING**

Course Objectives:

1. To develop proficiency in implementing fundamental programming constructs such as loops, conditionals, functions, and arrays in C language through hands-on lab exercises.
2. To Gain practical experience in implementing and using data structures like arrays, linked lists, stacks, and queues to solve programming problems during lab sessions.
3. To Enhance problem-solving skills by applying algorithms learned in theory to practical programming tasks.
4. To engage in project-based learning activities where students work in teams to tackle larger programming projects.
5. To acquire skills in debugging and error handling techniques by identifying and resolving common programming errors encountered during lab exercises, ensuring robust and error-free code.

Nature of Paper: VAC (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Develop a program that performs basic arithmetic operations (addition, subtraction, multiplication, division) based on user input.
Practical-2.	Create a program to convert temperatures between Celsius, Fahrenheit, and Kelvin.
Practical-3.	Build a basic ATM simulation that allows users to check balance, deposit, and withdraw money.
Practical-4.	Develop a program to simulate a simple voting system with options and tallying votes.
Practical-5.	Create a program to calculate student grades based on user input of marks.
Practical-6.	Write a program that identifies whether a number is odd or even.
Practical-7.	Develop a program to check if a given year is a leap year.
Practical-8.	Create a program to solve quadratic equations.
Practical-9.	Implement a menu-driven program that performs different tasks like calculating area, volume, etc., based on user choice.
Practical-10.	Develop a recursive function to compute the factorial of a number.

Practical-11.	Develop a program to store and manipulate student marks using arrays. Calculate average, highest, and lowest marks.
Practical-12.	Implement a program to perform multiplication of two matrices.
Practical-13.	Create a function to reverse a string without using library functions.
Practical-14.	Write a program to dynamically allocate memory for an array and perform operations on it (e.g., finding the maximum element).
Practical-15.	Implement linear and binary search algorithms to find an element in an array
Practical-16.	Develop a program to check if a given string is a palindrome.
Practical-17.	Create a function that swaps two variables using pointers.
Practical-18.	Write a program to count the frequency of each character in a string.
Practical-19.	Develop a program to dynamically resize an array as elements are added or removed.
Practical-20.	Implement a function to concatenate two strings without using library functions.
Practical-21.	Create a program to manage employee records using structures.
Practical-22.	Implement a program to store and retrieve student details using file handling.
Practical-23.	Write a program to copy contents from one file to another.
Practical-24.	Create a payroll system that calculates and displays employee salaries, storing the data in files.
Practical-25.	Implement an inventory management system to track products using structures and file handling.
Practical-26.	Develop a program to manage patient records using structures and files.
Practical-27.	Create a program to demonstrate file error handling techniques.
Practical-28.	Write a program to generate student grade reports and save them in a file.
Practical-29.	Implement a singly linked list with operations like insertion, deletion, and traversal.
Practical-30.	Create a program to implement stack operations using arrays and linked lists.
Practical-31.	Develop a program to simulate a queue using arrays and linked lists.
Practical-32.	Write a program to count the number of words in a text file.
Practical-33.	Implement a program using macros for basic arithmetic calculations.
Practical-34.	Develop a program to recursively list all files in a directory (if operating system access is allowed).
Practical-35.	Implement a basic Sudoku solver using backtracking and recursion.
Practical-36.	Develop a comprehensive project simulating bank transactions including account creation, deposit, withdrawal, and balance inquiry, integrating structures, file handling, and dynamic memory allocation.

Text Books:

1. *Computer Programming with C, Special Edition-MRCET, Mc Graw Hill Publishers 2017,*
2. *Computer Science: A Structured Programming Approach Using C, B, A, Forouzan and R, F, Gilberg, Third Edition, Cengage Learning,*

Reference Books:

1. *The C Programming Language, B, W, Kernighan and Dennis M, Ritchie, PHI*

2. *Computer Programming, E, Balagurusamy, First Edition, TMH*
3. *C and Data structures – P, Padmanabham, Third Edition, B, S, Publications,*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Able to develop programs that perform fundamental arithmetic operations	**L2 & L3**
CO-2	Ale to use arrays, pointers, and structures by creating programs for matrix multiplication, student mark storage, employee records management, and dynamically resizing arrays	**L3 &L4**
CO-3	Able to implement recursive functions, linear and binary search algorithms	**L1& L3**
CO-4	will learn to manage data using file handling techniques, including storing and retrieving student details, copying file contents, generating grade reports, and handling file errors, essential for real-world applications	**L2 & L3**
CO-5	will apply their theoretical knowledge to practical, real-life scenarios, integrating multiple programming concepts seamlessly	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	1	0	0	0	1	2	3
CO-2	3	3	3	2	1	1	0	0	0	1	1	3
CO-3	3	3	3	3	1	0	0	0	0	0	1	3
CO-4	3	3	3	2	21	1	0	0	0	1	2	3
CO-5	3	3	3	3	2	1	0	0	0	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I/II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: PROFESSIONAL COMMUNICATION LAB**
Course Code: ENAS-114P/ ENAS-124P	**Title: PROFESSIONAL COMMUNICATION LAB**

Course Objectives:

1. To enhance students' ability to communicate effectively in social and professional settings
2. To focus on the correct pronunciation and intonation patterns of English to ensure clear and understandable speech
3. To provide a solid foundation in English grammar and expand vocabulary for more accurate and expressive language use
4. To develop active listening skills and improve comprehension abilities through focused practice and exercises
5. To equip students with essential soft skills such as interview handling, email etiquette, and presentation skills to succeed in professional environments.

Nature of Paper: AECC (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0	T: 0	P: 2	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title(English-Wordsworth-Language Lab)
Module-1.	**Communication Skills –** 1. Social Meeting People & Asking Questions 2. Making Friends 3. Dos & Don'ts 4. What do you do?
Module-2.	**English Concepts –** 1. Tenses 2. Parts of Speech 3. Figures of Speech 4. Direct & Indirect Speech
Module-3.	**Pronunciation –** 1. Phonetics & Intonations 2. Vowels, Consonants, Nouns
Module-4.	**Communication Skills –** 1. Listening Skills 2. Speaking Skills 3. Reading Skills

	4. Writing Skills
Module-5.	**Advance Learning & Soft Skills –** 1. Effective Communication 2. Interview Handling Skills 3. Email Etiquette 4. Presentation Skills 5. Listening Comprehension

Text Books/Reference Books:

1. *Daniel Jones: English Pronouncing Dictionary*
2. *R.K. Bansal: Phonetics in English*
3. *Sethi and Dhamija: A Course in English Phonetics*
4. *S.D. Sharma: A Text-Book of Professional Communication & ESP*
5. *S.D. Sharma: Manual on Communication Lab English*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Students will demonstrate improved ability to meet and engage with people, make friends, and handle social interactions confidently and appropriately	**L2 & L3**
CO-2	Students will exhibit correct pronunciation, intonation, and the ability to articulate vowels, consonants, and nouns clearly	**L3 &L4**
CO-3	Students will show proficiency in using tenses, parts of speech, and figures of speech in both written and spoken English	**L1& L3**
CO-4	Students will display heightened listening skills and the ability to comprehend and respond accurately to spoken and written English	**L1 & L4**
CO-5	Students will be able to effectively manage interviews, compose professional emails, and deliver impactful presentations, showcasing their preparedness for professional scenarios	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	1	0	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	2	2	1	0	0	0	0	1	2
CO-3	0	2	2	2	1	0	0	0	0	0	1	2
CO-4	1	3	2	2	2	0	0	0	0	0	1	1
CO-5	1	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: ELECTRONICS IN THE MODERN WORLD LAB**
Course Code: ENEE-121P	**Title: ELECTRONICS IN THE MODERN WORLD LAB**

Course Objectives:
1. To analyze a given network by applying various electrical laws.
2. To analyze a given network by applying various electrical network theorems
3. To know the response of electrical circuits for different excitations
4. To calculate, measure and know the relation between basic electrical parameters
5. To calculate, measure and know the relation between basic electronics parameters

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & (50% of External Assessment)

L: 0	**T:** 0	**P:** 2	**C:** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Verification of Ohms Law.
Practical-2.	Verification of KCL and KVL for DC Circuits.
Practical-3.	Verification of Superposition Theorem.
Practical-4.	Verification of Thevenin`s Theorem
Practical-5.	Verification of Norton`s Theorem
Practical-6.	Verification of Maximum Power Transfer Theorem
Practical-7.	Calculations and Verification of Impedance and Current of RL, RC and RLC series Circuits.
Practical-8.	Measurement of Voltage, Current and Real Power in primary and Secondary AC Circuits
Practical-9.	The identification & Testing of Electronic component.
Practical-10.	Diode Characteristics (Si) a) Forward Bias b) Reverse Bias
Practical-11.	Study and analysis of half Wave rectifier with & without filter.
Practical-12.	Study and analysis of full Wave rectifier with & without filter.
Practical-13.	Transistor CE Characteristics (I/P & O/P)

Text Books:

1. Robert L. Boylestand / Louis Nashelsky "Electronic Devices and Circuit Theory", Pearson Education.
2. R. Muthusubramanian, S. Salivahanan, "Basic Electrical and Electronics Engineering", Tata McGraw-Hill Education, Reprint 2012
3. George Kennedy, "Electronic Communication Systems", McGraw Publication

Reference Books:

1. David A. Bell, "Electronic Devices and Circuits", Oxford University Press.
2. Jacob Millman, C.C. Halkias, StayabrataJit, "Electronic Devices and Circuits", McGraw Hill
4. David A. Bell, Electronic Instrumentation and Measurements, Latest Edition, Oxford Uni Press India

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3)External Practical Assessment	External Assessment	20
4)Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Create basic electrical connections for domestic applications	**L2 & L3**
CO-2	Measure the various electrical parameters in the DC circuit	**L3 &L4**
CO-3	Measure the various electrical parameters in the AC circuit	**L1& L3**
CO-4	To study basic electronic components.	**L2 & L3**
CO-5	To get the practical expose of the Transistors applications.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	2	2	1	0	0	0	0	1	2
CO-3	3	3	2	2	1	0	0	0	0	0	1	2
CO-4	3	3	2	2	2	0	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: ELECTRICAL & ELECTRONICS IN THE MODERN WORLD**
Course Code: ENEE-121	**Title: ELECTRICAL & ELECTRONICS IN THE MODERN WORLD**

Course Objectives:

1. To provide students with a foundation in basic electrical and electronic principles.
2. To develop the ability to simplify complex DC networks
3. To introduce semiconductors and devices used in computers and modern electronics.
4. To connect electronics concepts with applications in computing, IoT, and automation.
5. To enable students to perform simple hands-on experiments using electronic components and microcontrollers.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	**T:** 1	**P:** 0	**C:** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Fundamentals of Electrical & Circuits • Voltage, current, resistance, power (basic quantities) • Passive Components: Resistors, capacitors, inductors: functions, uses, and color coding • Ohm's Law and simple circuit calculations • Series and parallel combination of resistance, • AC vs DC supply (very basic introduction) • Application: Power supply in computers, mobile	**9L**
II	**DC Circuits** • Introduction to DC circuits, • Star-Delta conversion. • Kirchhoff's laws, • Mesh and nodal methods of analysis, • DC theorems: Thevinen's Theorem Norton's theorem, Maximum Power Transfer Theorem,	**9L**
III	Introduction to Electronics: Semiconductor Basics & Devices • Difference between electrical and electronics • Role of electronics in computing, communication, healthcare, and	**9L**

	automation • Conductors, semiconductors, insulators • Intrinsic & extrinsic semiconductors (p-type, n-type – simple explanation) • Active Components: Diodes, transistors, LEDs, ICs • PN junction diode: forward/reverse bias, • Transistors: concept as switch & amplifier	
IV	Digital Electronics & Logic • Binary number systems & voltage levels (0s and 1s) • Logic gates: AND, OR, NOT, NAND, NOR (truth tables & symbols) • Simplification of Boolean functions using K- Mapp (Upto 4 variables) • Simple combinational logic (half adder, encoder/decoder – basic idea)	**9L**
V	Electronics in the Modern World • Motherboards, chipsets, RAM, processors (basic blocks) • Consumer electronics: smartphones, smart TVs, laptops • Computer hardware: power supply, microprocessor basics • IoT and Embedded Systems: microcontrollers (Arduino, Raspberry Pi), sensors & actuators • Applications in automation, wearables, renewable energy devices • Emerging technologies: AI chips, quantum computing (intro only)	**9L**

Text Books:

1. Robert L. Boylestand / Louis Nashelsky "Electronic Devices and Circuit Theory", Pearson Education.
2. R. Muthusubramanian, S. Salivahanan, "Basic Electrical and Electronics Engineering", Tata McGraw-Hill Education, Reprint 2012
3. George Kennedy, "Electronic Communication Systems", McGraw Publication

Reference Books:

1. David A. Bell, "Electronic Devices and Circuits", Oxford University Press.
2. Jacob Millman, C.C. Halkias, Stayabrata Jit, "Electronic Devices and Circuits", McGraw Hill
3. David A. Bell, Electronic Instrumentation and Measurements, Latest Edition, Oxford Uni Press India

If the course is available as **Generic Elective**, then the students of following departments may opt it: NO

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Physics of Class 12

Course Learning Outcomes:

CO-1	Apply the fundamental laws of electricity and circuit analysis to solve basic	**L2 & L3**

	AC/DC circuit problems.	
CO-2	**Analyze** DC circuits using Kirchhoff's laws, network theorems, and circuit simplification methods.	**L3 &L4**
CO-3	**Explain** the working of semiconductor devices and their applications in switching and amplification.	**L1& L3**
CO-4	**Demonstrate** the use of digital electronics concepts including number systems, logic gates, and basic combinational circuits.	**L2 & L3**
CO-5	**Recognize** modern electronic systems, IoT devices, and emerging technologies in computing and automation.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: Introduction to CNC and 3-D Printer Lab**
Course Code: ENME-123P	**Title: Introduction to CNC and 3-D Printer Lab**

Course Objectives:

1. Understanding CNC and 3D Printing Technologies
2. Gain hands-on experience with CNC machines and 3D printers, including setup, operation, maintenance, and troubleshooting.
3. Identify and select appropriate materials for CNC machining and 3D printing based on their properties and application requirements.
4. Apply quality control methods and standards to ensure the production of high-quality parts.\
5. Explore the diverse industry applications of CNC machining and 3D printing, including automotive, aerospace, healthcare, and consumer products

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Marks (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Overview of CNC machine components and functions.
Practical-2.	Introduction to G-code and M-code.
Practical-3.	Writing simple CNC programs for basic shapes (e.g., square, circle).
Practical-4.	Loading and securing the workpiece along with tool selection and tool path setup.
Practical-5.	Programming and executing 2D milling operations to Creating a flat surface, slot, and pocket milling.
Practical-6.	Overview of CNC lathe operations along with programming and executing turning operations (e.g., facing, turning, threading).
Practical-7.	Introduction to CNC simulation software and Simulating CNC programs to verify tool paths and operations.
Practical-8.	Overview of 3D printing technology and applications along with Safety procedures and lab protocols.
Practical-9.	Understanding the parts of a 3D printer. With Basics of printer maintenance and troubleshooting. .
Practical-10.	Introduction to CAD software (e.g., Tinkercad, Fusion 360).
Practical-11.	Designing simple 3D models for printing.

Practical-12.	Introduction to slicing software (e.g., Cura, Prusa Slicer).
Practical-13.	Developing a small project that incorporates both CNC and 3D printing techniques

Reference/Text Books:

1. *"CNC Programming" S K Sinha*
2. *" Functional Design for 3D" by Mr Clifford T Smyth*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3)External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Understanding CNC and 3D Printing Technologies	**L2 & L3**
CO-2	Gain hands-on experience with CNC machines and 3D printers, including setup, operation, maintenance, and troubleshooting.	**L3 &L4**
CO-3	Understand the properties and selection criteria of various materials used in CNC machining and 3D printing	**L1& L3**
CO-4	Develop skills in designing 3D models suitable for CNC machining and 3D printing, including considerations for manufacturability and printability.	**L2 & L3**
CO-5	Understand quality control methods and standards for parts produced by CNC machining and 3D printing.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I/II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: Mechanical Workshop Lab**
Course Code: ENME-112P/ENME-122P	**Title: Mechanical Workshop Lab**

Course Objectives:

1. To understand the importance of tools used in workshop.
2. To prepare various joints used in workshop.
3. To identify & apply the most appropriate tools for various applications.
4. To perform the various types of black smithy and sheet metal shop operations.
5. Introduce students to the fundamentals of Computer Numerical Control (CNC) machines, including their components, operation principles, and applications in modern manufacturing.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 3	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Module-1	**Carpentry Shop:** **Practical-1:** To prepare half-lap corner joint. **Practical-2:** To prepare mortise & Tenon joint. **Practical-3:** To prepare a cylindrical pattern on woodworking lathe
Module-2	**Fitting Bench Working Shop:** **Practical-1:** To prepare a V-joint fitting **Practical-2:** To prepare a U-joint fitting **Practical-3:** To make a perfect square job
Module-3	**Black Smithy Shop:** **Practical-1:** To prepare a square rod from given circular rod. **Practical-2:** To prepare a square S- shape from given circular rod. **Practical-3:** To prepare a nail from given circular rod.
Module-4	**Welding Shop:** **Practical-1:** To prepare a butt welded joints using arc welding machine. **Practical-2:** To prepare a "T" welded joints using MIG welding machine. **Practical-3:** To prepare a Lap welded joint using resistance spot welding machine.
Module-5	**Sheet-metal Shop:** **Practical-1:** To make round duct of GI sheet using 'soldering' process. **Practical-2:** To prepare a tray of GI by fabrication

Module-6	**Machine Shop:** **Practical-1:** To prepare a bolt on the lathe machine as per given. Diagram. **Practical-2:** To prepare a slot on the horizontal milling machine as per given diagram.
Module-7	**Foundry Shop:** **Practical-1:** To prepare core as per given size. **Practical-2:** To prepare a mould for given casting.
Module-8	**CNC Shop:** **Practical-1:** Learn about the components of a CNC machine and their functions. **Practical-2:** Learn how to set up a work piece in the CNC machine (fixturing, tooling, work holding). **Practical-3:** Understand the process of loading tools into the machine and tool length offsets. **Practical-4:** Mount the cutting tool on the tool post and set its position relative to the work piece. **Practical-5:** To prepare a turning job on a CNC lathe machine according to a given diagram.

Reference/Text Books:

1. *A Course In Workshop Technology (Manufacturing Processes Vol. 1, B.S. Raghuwanshi, Publisher, Dhanpat Rai & Co.*
2. *Manufacturing Processes, Kumar & Gupta, Prentice Hall India.*
3. *Production Technology, Jain, Khanna Publications.*
4. *CNC Machining for Beginners by Paul Smith*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce (External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Understand the tools used in workshop & their applications.	**L2 & L3**
CO-2	Prepare various joints used in carpentry, fitting and welding shop.	**L3 &L4**
CO-3	Identify & apply the most appropriate tools for various manufacturing operations like turning, facing and threading.	**L1& L3**
CO-4	Perform the various types of black smithy and sheet metal shop operations.	**L2 & L3**
CO-5	Students will demonstrate proficiency in setting up CNC machines, loading programs, and executing machining operations to achieve specified dimensions and tolerances.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	0	3	0	0	0	1	0	0	2	1
CO-2	0	3	3	3	0	1	3	1	1	1	2	1
CO-3	0	2	2	2	3	2	0	0	0	2	2	2
CO-4	0	2	2	1	2	1	0	0	0	0	3	1
CO-5	1	2	1	1	1	0	0	0	0	0	0	0

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: I/II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: Engineering Graphics & Design Lab**
Course Code: ENME-113P/ ENME-123P	**Title: Engineering Graphics & Design Lab**

Course Objectives:

1. To study the standard and rules to be trailed by engineers for making precise drawings.
2. To understand the fundamental dimensioning practices that must be continued in the arrangement of drawings.
3. To draw the various types of projection of lines, planes and solids.
4. To apply the CAD for design.
5. To create the engineering models.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 1

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Introduction to Engineering Drawing, Orthographic Projections: Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain and Diagonal Scales. Principles of Orthographic Projections – Conventions – Projections of Points and Lines inclined to both planes; Projections of planes inclined Planes – Auxiliary Planes.
Practical-2.	Projections and Sections of Regular Solids: Sections in lined to both the Planes – Auxiliary Views; Simple annotation, dimensioning and scale. Floor plans they include: windows, doors. Prism, Cylinder, Pyramid, Cone – Auxiliary Views.
Practical-3.	Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conversions.
Practical-4.	Computer Graphics: Listing the computer technologies the impact on graphical communication, Demonstration knowledge of the theory of CAD software [such as: The Menu System, Tollbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects: Isometric Views of lines, Planes, Simple and compound Solids];
Practical-5.	Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and

	tolerancing; Orthographic constraints, Snap to objects manually and automatically; Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen), Computer-aided design (CAD) software modeling of parts and assemblies.

Reference/Text Books:

1. Engineering Drawing, Bhatt N.D., Panchal V.M. & Ingle P.R. (2014), Charotar Publishing House.
2. Engineering Drawing, Narayana, K.L. & P Kannaiah (2008), Scitech Publishers.
3. Engineering Drawing Paperback, P.S. Gill (Author), S.K. Kataria & Sons.
4. Engineering Drawing and Computer Graphics, Shah, M.B. & Rana B.C. (2008), Pearson Education.
5. Engineering Graphics, Agrawal B. & Agrawal C.M. (2012), TMH Publication.
6. Engineering Graphics & Design, A.P. Gautametc, Khanna Publishing House.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce (External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Understand the basic concepts and principles of engineering graphics and their significance.	**L2 & L3**
CO-2	Understand the theory of projections and regular solids.	**L3 &L4**
CO-3	Draw the various types of projection of lines, planes and solids.	**L1& L3**
CO-4	Apply the CAD for design.	**L2 & L3**
CO-5	Creating the engineering models using solid modeling.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	0	0	0	0	1	0	0	0	2	0	0
CO-2	3	2	0	0	0	1	0	0	0	0	0	0
CO-3	3	0	3	0	1	0	0	0	0	2	0	0
CO-4	2	0	2	0	3	0	0	0	0	1	0	0
CO-5	2	0	3	1	3	0	0	0	0	0	2	0

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech ME**	**Year: I** **Semester: II**
Credits: NA **Theory: 0** **Practical: 0**	**SUBJECT: SPIRITUAL AND CULTURAL HERITAGE: INDIAN EXPERIENCE**
Course Code: ENPH-111	**TITLE: SPIRITUAL AND CULTURAL HERITAGE: INDIAN EXPERIENCE**

Course Objectives:

1. To provide an overview of the foundations of Indian knowledge systems through the Vedas, Upanishads, epics, and traditional sciences.
2. To develop appreciation for India's rich heritage in art, architecture, literature, and languages.
3. To introduce the major Indian philosophical schools and contributions of spiritual thinkers.
4. To foster understanding of cultural identity and values rooted in Indian traditions
5. To highlight the modern relevance and global impact of Indian knowledge and heritage.

Nature of Paper: Audit Course (Lab)

Minimum Passing Marks/Credits: NA

L :	T : 0	P : 2	C : 0

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to Indian Knowledge Systems and Cultural Identity	**4L**
II	Vedas, Upanishads, Epics and Traditional Indian Sciences	**4L**
III	Art, Architecture, Literature and Languages of India	**4L**
IV	Indian Philosophical Schools and Spiritual Thinkers	**4L**
V	Modern Relevance and Global Impact of Indian Heritage	**4L**

Text Books:

1. The Essentials of Indian Philosophy by M. Hiriyanna. Motilal Banarsidass
2. Indian Philosophy by S. Radhakrishnan, Oxford University Press.
3. India: A Sacred Geography by Diana L. Eck. Three Rivers Press
4. The Wonder That Was India **by** A.L. Basham, Picador.
5. Cultural Heritage of India (Vols 1–5) by Ramachandra Rao, Bharatiya Vidya Bhavan

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	NA
2) Presentations /Seminar	25
3) Assignments	NA

4) Research Project Report Seminar On Research Project Report	NA
5) ESE	NA
Total:	**NA**

Prerequisites for the course: NA

Course Learning Outcomes:

CO-1	Recognize the diversity and unity of Indian cultural traditions.	**L2 & L4**
CO-2	Understand the philosophical and spiritual essence of Indian scriptures.	**L3 &L4**
CO-3	Analyze the contributions of Indian heritage to global knowledge systems.	**L3 & L4**
CO-4	Appreciate art, literature, architecture and their cultural context.	**L2 & L3**
CO-5	Develop respect for Indian values, thought, and wisdom traditions.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	1	0	1	0	1	0	0	0	0	0	0	0
CO-2	0	1	1	1	1	1	0	0	0	0	0	0
CO-3	1	1	0	1	0	0	0	0	0	0	0	0
CO-4	0	0	0	1	1	1	0	0	0	0	0	0
CO-5	0	1	1	0	0	1	0	0	0	0	0	0

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**	**Year: I** **Semester: II**
Credits: NA **Theory: 0** **Practical: 0**	**Subject: APPLIED DIFFRENTIAL EQUATIONS**
Course Code: ENAS-121	**Title: APPLIED DIFFRENTIAL EQUATIONS**

Course Objectives:

1. To understand the effective mathematical tools for the solutions of differential equations that model physical processes.
2. To get the idea of types of partial differential equations and their solutions.
3. To understand the concept of Laplace Transform and its application to solve differential and integral equations.
4. To understand and apply the foundational knowledge and analytical skills of Fourier series in solving engineering problems.
5. To equip students with the knowledge and skills to formulate and solve linear programming problems for optimal decision-making in engineering applications.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: NA

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**ORDINARY DIFFERENTIAL EQUATIONS:** Linear differential equation of nth order with constant coefficients, Simultaneous linear differential equations, Second order linear differential equations with variable coefficients, Solution by changing independent variable, Reduction of order, Normal form, Method of variation of parameters, Cauchy-Euler equation.	9L
II	**PARTIAL DIFFERENTIAL EQUATIONS:** Origin of Partial Differential Equations, Linear and Non Linear Partial Equations of first order, Lagrange's Equations, Charpit's method, Solution of Linear Partial Differential Equation of Higher order with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients.	9L
III	**LAPLACE TRANSFORM:** Laplace transform, Existence theorem, Laplace transforms of derivatives and integrals, Initial and final value theorems, Unit step function, Dirac- delta function, Laplace transform of periodic function, Inverse Laplace transform, Convolution theorem, Application to solve simple linear and simultaneous differential equations.	9L

IV	**FOURIER SERIES:** Euler's Formulae, Functions having arbitrary periods,πPeriodic functions, Fourier series of period 2 Change of interval, Even and odd functions, Half range sine and cosine series.	**9L**
V	**Linear Programming and Optimization:** Definition and importance of Linear Programming in engineering and optimization, Real-life applications of Linear Programming in various fields, Formulation of Linear Programming Problems, Solution of Linear Programming Problems using the Graphical Method, Simplex Method, Concept of duality in Linear Programming, Dual Simplex Method.	**9L**

Text Books:

1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*
4. *S.D. Sharma, Operation Research, Kedar Nath Ram Nath Publications*

Reference Books:

1. *E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.*
2. *Veerarajan T., Engineering Mathematics for first year, McGraw-Hill, New Delhi, 2008.*
3. *R K. Jain & S R K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House 2002*
4. *H.A. Taha, Operation Research-An introduction, Printice Hall of India*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Engineering Mathematics-I (RTAS-111)

Course Learning Outcomes:

CO-1	to solve linear differential equations of nth order with constant coefficients, and apply methods to solve various types of differential equations including Cauchy-Euler equations.	**L2 & L4**
CO-2	to formulate and solve first and higher-order partial differential equations using methods like Lagrange's equations, Charpit's method	**L3 &L4**
CO-3	demonstrate proficiency in using Laplace transforms to solve differential equations using theorems related to initial and final values, convolution, and the inverse Laplace transform.	**L3 & L4**
CO-4	able to represent periodic functions using Fourier series, understand and apply Euler's formulas, and construct Fourier series for functions of arbitrary periods and half-range expansions, identifying even and odd functions.	**L2 & L3**

CO-5	will develop the ability to formulate linear programming problems, solve them and understand the concept of duality in linear programming, with applications to real-life optimization problems in various fields.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	2	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	3	3	2	0	0	0	0	0	1	3
CO-4	3	3	2	3	2	1	0	0	0	0	1	2
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**	**Year: I** **Semester: II**
Credits: NA **Theory: 0** **Practical: 0**	**SUBJECT: HEALTH AND WELLNESS**
Course Code: ENHW-121	**TITLE: HEALTH AND WELLNESS**

Course Objectives:

1. To introduce the concept and dimensions of health and wellness for a balanced lifestyle.
2. To develop awareness about nutrition, physical activity, and preventive measures against lifestyle diseases.
3. To promote mental and emotional well-being through stress management, mindfulness, and emotional intelligence.
4. To create awareness about substance abuse, its health risks, and strategies for prevention.
5. To educate students on public health practices, hygiene, first-aid, and digital wellness.

Nature of Paper: Audit Course (Lab)

Minimum Passing Marks/Credits: NA

L :	**T : 0**	**P :** 2	**C :** 0

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to Health and Wellness: Definition and dimensions of health, importance of wellness, lifestyle diseases and their prevention.	**4L**
II	Nutrition and Physical Activity: Basics of a balanced diet, nutrients and their sources, physical activity guidelines, benefits of exercise and yoga.	**4L**
III	Mental and Emotional Well-being: Understanding stress, coping mechanisms, emotional intelligence, mindfulness practices, importance of sleep.	**4L**
IV	Substance Abuse and Health Risks: Awareness about tobacco, alcohol, drugs; addiction prevention; understanding peer pressure and making informed choices.	**4L**
V	Public Health and Digital Wellness: Hygiene and sanitation, preventive healthcare, first-aid basics, digital wellness, screen time management, online health resources.	**4L**

Text Books:

1. Textbook of Health and Physical Education by Dr. V.K. Sharma, Saraswati House
2. Health and Wellness by Dr. Anjali Arora. Penguin Books India
3. The Wellness Sense by Om Swami, Jaico Publishing House
4. Essentials of Physical Education by K. Goel, Goyal Brothers Prakashan
5. Fitness and Wellness by Wener W.K. Hoeger & Sharon A. Hoeger, Cengage Learning

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology	
Category	**Max. Marks**
1) Class tasks/ Sessional Examination	NA
2) Presentations /Seminar	25
3) Assignments	NA
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	NA
Total:	**NA**

Prerequisites for the course: NA

Course Learning Outcomes:

CO-1	Understand the importance of holistic health and identify factors affecting wellness.	**L2 & L4**
CO-2	Apply principles of nutrition and physical fitness for a healthy lifestyle.	**L3 &L4**
CO-3	Demonstrate awareness of mental and emotional health practices.	**L3 & L4**
CO-4	Recognize harmful substances and develop resistance to negative peer influence.	**L2 & L3**
CO-5	Practice good hygiene and digital wellness using available health resources.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	1	0	1	0	1	0	0	0	0	0	0	0
CO-2	0	1	1	1	1	1	0	0	0	0	0	0
CO-3	1	1	0	1	0	0	0	0	0	0	0	0
CO-4	0	0	0	1	1	1	0	0	0	0	0	0
CO-5	0	1	1	0	0	1	0	0	0	0	0	0

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Fundamental Concepts and Problem Solving with Python**
Course Code: ENCS-121	**Title: Fundamental Concepts and Problem Solving with Python**

Course Objectives:
1. To be able to introduce core programming basics.
2. To understand a range of Object-Oriented Programming, as well as in-depth data and information processing techniques.
3. To understand data types, statement, operators, modules, list, tuple, and dictionaries.

Nature of Paper: VAC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Python Programming:** History and evolution of Python, Features and advantages, Installation and setup (Python IDEs, Jupyter Notebook, Anaconda) **Basic Syntax:** Python syntax and semantics, Writing and executing a Python script, Indentation and code structure **Data Types and Variables:** Basic data types (int, float, str, bool), Variable declaration and assignment, Type conversion and casting **Operators and Expressions:** Arithmetic, relational, logical, and bitwise operators, Operator precedence and associativity.	9L
II	**Control Structures and Functions:** **Control Flow Statements:** Conditional statements (if, if-else, nested if-else), Looping statements (for, while, nested loops), Control statements (break, continue, pass), **Functions:** Defining and calling functions, Function arguments and return values, Recursion, Lambda functions and anonymous functions, **Modules and Packages:** Importing modules and using standard libraries, Creating and using custom modules, Introduction to virtual environments	9L
III	**Data Structures in Python:** **Strings:** String operations and methods, String formatting and manipulation, **Lists:** List operations and methods, List comprehensions, Nested lists, **Tuple:** Tuple operations and methods, Advantages of using tuples,	9L

	Dictionaries: Dictionary operations and methods, Dictionary comprehensions, Nested dictionaries, **Sets:** Set operations and methods, Set theory operations (union, intersection, difference)	
IV	**Problem Solving and File Handling:** **Problem Solving Techniques:** Algorithm design and pseudocode, Flowcharts, Debugging and testing, Exception handling (try, except, finally) **File Handling:** Reading from and writing to files, File methods and operations (open, close, read, write, append), Working with CSV and JSON files **Regular Expressions:** Introduction to regular expressions, Using the **re** module for pattern matching	**9L**
V	**Advanced Topics and Future Technologies:** **Object-Oriented Programming (OOP):** Classes and objects, Inheritance, polymorphism, encapsulation, and abstraction, Magic methods and operator overloading **Introduction to Data Science:** Basics of NumPy and Pandas, Data analysis and manipulation, Visualization with Matplotlib and Seaborn. **Future Prospects:** Career opportunities and industry trends, Ethical considerations in technology	**9L**

Text Books:
1. Python Crash Course.
2. Head-First Python, 2nd edition

Reference Books:
1. Guido van Rossum, and Fred L. Drake, Jr. (Editor)ISBN: 1906966141
2. Network Theory Ltd, 120 pages (Revised November 2006)

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: solid computer literacy.

Course Learning Outcomes:

CO-1	To define the structure and components of a Python program.	**L2 & L3**
CO-2	To learn how to build and package Python modules for reusability.	**L3 &L4**
CO-3	To learn how to write functions and pass arguments in Python.	**L1& L3**
CO-4	To learn how to read and write files in Python.	**L2 & L3**
CO-5	To learn how to design object-oriented programs with Python classes.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)												
CO-PO Mapping												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	1	0	3	0	0	0	0	0	0	1
CO-2	3	2	2	0	3	0	0	0	0	0	1	2
CO-3	3	3	2	0	3	0	0	0	0	0	0	2
CO-4	3	3	1	0	3	0	0	0	0	0	1	2
CO-5	3	3	3	0	3	2	0	0	0	0	2	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**	**Year: I** **Semester: II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: Fundamental Concepts and Problem Solving with Python Lab**
Course Code: ENCS-121P	**Title: Fundamental Concepts and Problem Solving with Python Lab**

Course Objectives:

1. Develop proficiency in writing and executing basic Python programs
2. Implement core programming concepts including conditional statements, loops, and functions through practical tasks
3. Enhance problem-solving skills by tackling tasks such as swapping values without a third variable
4. Gain a strong grasp of data structures like lists, tuples, and dictionaries, and practice algorithms for operations like merging sorted lists, removing duplicates, and counting specific elements
5. Explore advanced Python features and libraries by creating classes, utilizing random functions

Nature of Paper: VAC (Lab)

Minimum Passing Marks/Credits: 50% marks / 1 Credits (50% of Internal Assessment&50% of External Assessment)

L: 0	**T:** 0	**P:** 2	**C:** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	**Practical Title**
Practical-1.	Write a Python program to print "Hello, World!".
Practical-2.	Implement a calculator that can perform addition, subtraction, multiplication, and division.
Practical-3.	Determine if a given year is a leap year.
Practical-4.	Swap the values of two variables without using a third variable.
Practical-5.	Check if a given string is a palindrome.
Practical-6.	Determine the maximum of three given numbers.
Practical-7.	Check if a number is an Armstrong number.
Practical-8.	Merge two sorted lists into a single sorted list.
Practical-9.	Remove duplicate elements from a list.
Practical-10.	Python program to count positive and negative numbers in a list.
Practical-11.	Python Program to Accept the Strings Which Contains all Vowels.
Practical-12.	Write a python Programming to find Maximum record value key in dictionary
Practical-13.	Python program to find tuple which have all elements divisible by K from a list of tuple

Practical-14.	Write a Python program to create a calculator class. Include methods for basic arithmetic operations.
Practical-15.	Write a Python function to find the maximum of three numbers.
Practical-16.	Write a Python program to select a random element from a list, set, dictionary-value, and file from a directory. Use random. Choice().
Practical-17.	Write a Python program to check if a function is a user-defined function or not. Use types. Function Type, types. Lambda Type().

Reference/Text Books:

- *Guido van Rossum, and Fred L. Drake, Jr. (Editor)ISBN: 1906966141*
- *Network Theory Ltd, 120 pages (Revised November 2006)*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	To Understand basic syntax of python implementation	**L2 & L3**
CO-2	To practically apply looping and conditional constructs	**L3 &L4**
CO-3	To implement program related with list data structure	**L1& L3**
CO-4	To implement various searching algorithm in python	**L2 & L3**
CO-5	To implement list, tuple, dictionary and modules	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	1	2	1	3	1	1	1	1	1	1	1
CO-2	3	2	2	2	3	1	1	1	2	1	1	2
CO-3	3	3	2	2	3	1	1	1	2	1	1	2
CO-4	3	2	2	2	3	1	1	1	2	1	1	2
CO-5	3	2	2	3	3	1	1	1	2	1	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**	**Year: I** **Semester: II**
Credits: NA **Theory: 0** **Practical: 0**	**Subject: Sports**
Course Code: SPT-PC-111	**Title: Sports**

Course Objectives: The objectives of studying this course are

1. To develop students' physical fitness, mental well-being, and proficiency in various individual and team sports through structured participation and practice.
2. To foster qualities of discipline, teamwork, sportsmanship, and strategic thinking by engaging students in competitive and recreational games and physical activities.

Nature of Paper: Core (Practical)

Minimum Passing Marks/Credits: NA

L: 0	**T:** 0	**P:** 2	**C:** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

S.No.	Contents	No. of Lectures Allotted
1	Archery/ Athletics/ Badminton/ Basketball/ Boxing/ Carrom/ Chess/ Cricket/ Football/ Handbal/l Judo/ Kabaddi/ Kho-Kho/ Martial Arts/ Powerlifting/ Table/ Tennis/ Volleyball/ Weightlifting/ Wrestling/ Yoga.	**2L**

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	15
2) Presentation/Seminar/Viva-Voce(Internal)		-
3) External Practical Assessment	External Assessment	35
4) Presentation/Seminar/Viva-Voce(External)		-
5) Practical Records		-
Total:		**50**

Prerequisites for the course: NA

Course Learning Outcomes:

CO-1	Demonstrate basic skills, rules, and techniques required for effective participation in individual sports such as athletics, archery, boxing, and martial arts.	**L3**

CO-2	Exhibit proficiency in team-based sports like football, basketball, volleyball, kabaddi, and kho-kho, with emphasis on coordination, communication, and team strategy	**L3, L4**
CO-3	Analyze and apply rules, scoring systems, and tactics in indoor games such as chess, carrom, and table tennis to enhance cognitive and decision-making skills.	**L4**
CO-4	Develop and maintain physical fitness, flexibility, and endurance through regular practice and participation in strength-based and aerobic activities such as yoga, powerlifting, and athletics	**L3**
CO-5	Demonstrate sportsmanship, ethical behavior, self-discipline, and leadership qualities both during practice and competitive events.	**L3,L5**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	2	1	2	1	1	–	–	–	2	1	–	2
CO-2	–	1	2	–	–	–	–	–	3	2	2	2
CO-3	1	2	–	–	1	–	–	2	2	2	–	2
CO-4	–	–	–	2	–	–	2	–	1	1	–	3
CO-5	–	–	–	–	–	3	–	3	3	2	3	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Engineering Mathematics-III**
Course Code: RTAS-231/RTAS-241	**Title: Engineering Mathematics-III**

Course Objectives:
1. To make the students familiar with complex functions and its calculus.
2. To deal with applications, residues, and conformal mapping.
3. To understand the concept and applications of integral transforms.
4. To deal with numerical solutions of algebraic equations and differential equations.
5. To understand the statistical aspect of functions.

Nature of Paper: Applied Science Courses(Core)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Functions of a Complex Variable I**: Analytic functions; C-R equations and harmonic functions; Line integral in the complex plane; Cauchy's integral theorem, Cauchy's integral formula for derivatives of analytic functions; Liouville's theorem.	9L
II	**Functions of a Complex Variable II**: Representation of a function by power series; Taylor's andLaurent's series; Singularities, zeroes, and poles; Residue theorem, evaluation of real integrals; conformal mapping and bilinear transformations.	9L
III	**Integral Transforms:** Fourier integral, Fourier complex transform, Fourier sine and cosine transforms and applications to simple heat transfer equations. Z – Transform and its application to solve difference equations.	9L
IV	**Numerical Techniques:** Solution of polynomial and transcendental equations Bisection method, Regula R – Falsi method, Newton - Raphson method. **Interpolation:** Finite difference, Newton's forward and backward interpolation, Lagrange's and Newton's divided difference formula for unequal intervals; **Numerical Differentiation**, **Numerical Integration**; Trapezoidal, Simpson's 1/3 and 3/8 rules. **Numerical solutions of first order differential equations** by Euler's method and 4th order Runge-Kuttamethod.	9L
V	**Statistical Techniques:** Moments, Moment generating functions, Skewness, Kurtosis, Curve Fitting and Solution of Equations: Method of least squares and	9L

	curve fitting of straight line and parabola, Correlation and Regression, Binomial distribution, Poisson distribution, Normal distribution.	

Text Books:

1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*

Reference Books:

1. *E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.*
2. *R K. Jain & S R K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House 2002.*
3. *Veerarajan T., Engineering Mathematics for first year, McGraw-Hill, New Delhi, 2008.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Engineering Mathematics-I (SEAS-111) & Engineering Mathematics-II (SEAS-121)

Course Learning Outcomes:

CO-1	Understand and check the Analyticity of a complex function.	**L2 & L3**
CO-2	To apply the concept of Analytic functions in residue and conformal mappings.	**L3 &L4**
CO-3	To solve and apply the concepts of transforms in the area of engineering.	**L1& L3**
CO-4	To solve numerically the Algebraic equations, Differential equations, and to differentiate & integrate numerically.	**L2 & L3**
CO-5	To understand and use the concept of statistical tools to analyze the different data.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Engineering Mathematics-III (RTAS-231/RTAS-241)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	2	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Operating System**
Course Code: RTCS-231	**Title: Operating System**

Course Objectives:

1. Student will be able to understand the structure and functions of OS
2. Student will be able to learn about Processes, Threads and Scheduling algorithms.
3. Student will be able to study and understand the principles of concurrency and Deadlocks
4. Student will be able to study and learn various memory management scheme.
5. Student will be able to study I/O management and File systems.

Nature of Paper: Engineering Courses (Core)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction of Operating system and functions, Classification of Operating systems- Batch, Interactive, Time sharing, Real Time System, Multiprocessor Systems, Multiuser Systems, Multi process Systems, Multithreaded Systems. Details of Operating System Structure- Layered structure, System Components, Operating System services, Reentrant Kernels, Monolithic and Microkernel Systems. Basics of UNIX/LINUX knowledge	9L
II	Process Concept, Different states of a Process, Process State transitions, Principle of Concurrency, Producer / Consumer Problem, Mutual Exclusion, Critical Section Problem, Dekker's solution, Peterson's solution, Semaphores, Test and Set operation. Classical Problem in Concurrency i.e Dining Philosopher Problem, Overview of Inter Process Communication models and Schemes, Process generation.	9L
III	CPU Scheduling: Scheduling Concepts, Performance Criteria, Process States, Process Transition Diagram, Schedulers, Process Control Block (PCB), Process address space, Process identification information, Threads and their management, Scheduling Algorithms, Multiprocessor Scheduling. Deadlock: System model, Deadlock characterization, Prevention, Avoidance and detection, Recovery from deadlock.	9L
IV	Memory Management: Basic bare machine, Resident monitor, Multiprogramming with fixed partitions, Multiprogramming with variable partitions, Protection schemes, Paging, Segmentation, Paged segmentation, Virtual memory concepts, Demand paging, Performance of demand paging, Page replacement algorithms, Thrashing, Implementing Malloc & Free, Cache memory organization, Locality of	9L

	reference. Virtual Memory for Linux.	
V	I/O Management and Disk Scheduling: I/O devices, and I/O subsystems, I/O buffering, Disk storage and disk scheduling, RAID. File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed),Free-space management (bit vector, linked list, implementation(linear list, hash table), efficiency and performance.	**9L**

Text Books:

1. *Silberschatz, Galvin and Gagne, "Operating Systems Concepts", Wiley.*
2. *Sibsankar Halder and Alex A Aravind, "Operating Systems", Pearson Education.*

Reference Books:

1. *Harvey M Dietel, "An Introduction to Operating System", Pearson Education.*
2. *William Stallings, "Operating Systems: Internals and Design Principles", 6th Edition, Pearson Education.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: NA

Course Learning Outcomes:

CO-1	Understand the structure and functions of OS	**L1& L2**
CO-2	Learn about Processes, Threads and Scheduling algorithms.	**L2 & L3**
CO-3	Understand the principles of concurrency and Deadlocks	**L3& L2**
CO-4	Learn various memory management scheme	**L2, L3 & L4**
CO-5	Study I/O management, Learn and implement File systems.	**L1& L2**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Operating system (RTCS-231)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	3	2	2	2	2	0	0	0	0	2
CO-2	2	3	2	3	3	1	1	0	0	0	0	2
CO-3	3	3	3	3	2	2	2	0	1	0	0	1
CO-4	3	3	3	2	2	2	2	0	0	0	0	1
CO-5	3	3	2	2	2	2	2	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Digital Logic System**
Course Code: RTCS-232	**Title: Digital Logic System**

Course Objectives:

1. To develop a strong foundation in analysis, design and implementation of digital electronic circuits.
2. To present the Digital fundamentals, Boolean algebra and its applications in digital systems
3. To familiarize with the design of various combinational digital circuits using logic gates
4. To introduce the analysis and design procedures for synchronous and asynchronous sequential circuit

Nature of Paper: Engineering Courses (Core)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L : 3	T : 1	P : 0	C : 4

Note: Theory - L:3 T:1 P:3(In Hours/Week) Theory - 1 Hr. = 1 Credit Practical- 2 Hrs. = 1 Credit (4 Hrs. / Week = 4 Credits)

Unit	Contents	No. of Lectures Allotted
I	**Digital System and Binary Numbers**: Number System and its arithmetic, Signed Magnitude Form (1's & 2's Compliment Form), Boolean Algebra, Binary codes,Logic Gates, NAND and NOR Gates implementation, Karnaugh Map Method(K-Map) up to five variable with Don't care conditions.	**9L**
II	**Combinational Circuits:** Basic Concepts**,** Binary Adder, Subtractor, n-bit parallel Adder & Subtractor, Magnitude Comparator, Multiplexers, Demultiplexers, Decoders, Encoders.	**9L**
III	**Sequential Circuits:** Flip-flop and Latch, SR flip-flop, JK flip-flop, T flip-flop, D flip-flop, Master-slave JK flip-flop, Flip Flop Conversion. **Registers:** Shift registers (SISO, SIPO, PISO, PIPO).	**9L**
IV	**Counters:** Asynchronous/Ripple counters, Synchronous counters, Modulus-n (MOD-N) Counter, Ring counter, Johnson counter, Up-Down counter.	**9L**
V	**Memory & Programmable Logic Devices:** RAM, ROM. Programmable Logic Devices (PLDs): Programmable Array Logic (PAL), Programmable Logic Array (PLA), Circuit Implementation using ROM, PLA and PAL.	**9L**

Text Books:

1. M. Morris Mano and M. D. Ciletti, "Digital Design", Pearson Education.
2. David J. Comer, "Digital Logic & State Machine Design", Oxford University Press.

Reference Books:

1. RP Jain, "Modern Digital Electronics", Tata McGraw Hill Publication.
2. Charles H Roth (Jr), Larry L. Kinney, "Fundamentals of Logic Design", Cengage Learning India Edition, 5th Edition, 2010.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NA**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: NA

Course Learning Outcomes: After completion of the course, the student should be able to:

CO-1	Understand the concept of number system, Logic Gates, Boolean algebra, K-map.	**L1& L2**
CO-2	Design of combinational logic circuits and their applications.	**L2 & L3**
CO-3	Understand concepts of Flip-Flops& Registers under the Sequential Circuits.	**L3& L2**
CO-4	Design of various Synchronous & Asynchronous Counters.	**L3 & L4**
CO-5	Gain the knowledge of designing & implementation of PLDs.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Digital Logic System (RTCS-232)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	3	2	2	2	2	0	0	0	0	2
CO-2	2	3	2	3	3	1	1	0	0	0	0	2
CO-3	3	3	3	3	2	2	2	0	1	0	0	1
CO-4	3	3	3	2	2	2	2	0	0	0	0	1
CO-5	3	3	2	2	2	2	2	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech CSE**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Theory of Computations**
Course Code: RTCS-233	**Title: Theory of Computations**

Course Objectives:

- Student will be able to analyze and design finite automata, pushdown automata, Turing machines, formal languages, and grammars
- Student will be able to analyze and design, Turing machines, formal languages, and grammars
- Student will be able to analyze and demonstrate the understanding of key notions, such as algorithm, computability, decidability, and complexity through problem solving
- Student will be able to analyze the basic results of the Theory of Computation.
  Student will be able to analyze, State and explain the relevance of the Church-Turing thesis.

Nature of Paper: Engineering Course (Core)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Theory of Computation-**Automata, Computability and Complexity, Alphabet, Symbol, String, Formal Languages. **Deterministic Finite Automaton (DFA)-**Definition, Representation, Acceptability of a String and Language **Non Deterministic Finite Automaton (NFA)-** Equivalence of DFA and NFA, NFA with ε-Transition **Finite Automata with output-** Moore Machine, Mealy Machine, Equivalence of Moore and Mealy Machine, Minimization of Finite Automata, Myhill-Nerode Theorem.	9
II	**Regular Expressions and Languages:** Regular Expressions, Transition Graph, Kleen's Theorem, Finite Automata and Regular Expression-Arden's theorem, Algebraic Method Using Arden's Theorem. Regular and Non-Regular Languages-Closure properties of Regular Languages, Pumping Lemma, Finite Automata and Regular Languages	9
III	**Regular and Non-Regular Grammars:** Context Free Grammar(CFG)-Definition, Derivations, Languages, Derivation Trees and Ambiguity, Regular Grammars-Right Linear and Left Linear grammars, Conversion of FA into CFG and Regular grammar into FA, Simplification of CFG, Normal Forms- Chomsky Normal Form(CNF), Greibach Normal Form (GNF), Chomsky Hierarchy	9

IV	**Push Down Automata:** Example of PDA, deterministic and non-deterministic PDA, conversion of PDA into context free grammar and vice versa, CFG equivalent to PDA, Petrinet model. Context Free grammars for Pushdown Automata	9
V	**Turing Machines, Decidability and Complexity:** Basic Turing Machine Model, Representation of Turing Machines, Language Acceptability of Turing Machines, Techniques for Turing Machine Construction , Universal Turing machine, Decidable and Undecidable Problems, Reducibility, Post Correspondence Problem, Complexity Classes: P, NP,NP-Complete and NP-Hard concepts	9

Text Books:

1. Introduction to Automata theory, Languages and Computation, J. E. Hopcraft, R. Motwani, and Ullman. 2nd edition, Pearson Education Asia.
2. Introduction to languages and the theory of computation, J Martin, 3rd Edition, Tata McGraw Hill.
3. Elements and Theory of Computation, C Papadimitrou, and C. L. Lewis, PHI

Reference Books:

1. Mathematical Foundation of Computer Science, Y. N. Singh, New Age International.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	**Max. Marks**
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Engineering Mathematics-I(SEAS-111) & Engineering Mathematics-II(SEAS-121)

Course Learning Outcomes:

CO-1	Analyze and design finite automata, pushdown automata, Turing machines, formal languages, and grammars.	**L2 & L3**
CO-2	Analyze and design, Turing machines, formal languages, and grammars.	**L3 &L4**
CO-3	Demonstrate the understanding of key notions, such as algorithm, computability, decidability, and complexity through problem solving.	**L1& L3**
CO-4	Prove the basic results of the Theory of Computation.	**L3**
CO-5	State and explain the relevance of the Church-Turing thesis.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Theory of Computations (RTCS-233)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	3	2	2	2	2	0	0	0	0	2
CO-2	2	3	2	3	3	1	1	0	0	0	0	2
CO-3	3	3	3	3	2	2	2	0	1	0	0	1
CO-4	3	3	3	2	2	2	2	0	0	0	0	1
CO-5	3	3	2	2	2	2	2	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: III**
Credits: 2 **Theory: 2** **Practical: 0**	**Subject: Computer Organization and Architecture**
Course Code: RSCS-231	**Title: Computer Organization and Architecture**

Course Objectives:

1. Student will be able to study basic structure and operation of a digital computer system.
2. Student will be able to analyze the design of arithmetic & logic unit and understanding of the fixed point and floating-point arithmetic operations.
3. Student will be able to implement control unit techniques and the concept of Pipelining.
4. Student will be able to understand the hierarchical memory system, cache memories and virtual memory
5. Student will be able to understand the different ways of communicating with I/O devices and standard I/O interfaces.

Nature of Paper: Skill Enhancement Course (Theory)

Minimum Passing Marks/Credits: 40% Marks / 2 Credits (30% of ESE & 40% of total)

L : 3	T : 0	P : 0	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction: Functional units of digital system and their interconnections, Overview of bus their architecture, types of buses and bus arbitration. Details of Register, bus and memory transfer. Processor organization, general registers organization, stack organization and addressing modes and their types	8L
II	**Arithmetic and logic unit:** Look ahead carries adders, Multiplication: Signed operand multiplication, Booths algorithm and array multiplier. Division and logic operations, Floating point arithmetic operation, Arithmetic & logic unit design. IEEE Standard for Floating Point Numbers.	8L
III	**Control Unit:** Instruction types, formats, instruction cycles and sub cycles (fetch and execute etc.), micro operations, execution of a complete instruction. Hardwire and micro programmed control: micro programming sequencing, concept of horizontal and vertical micro programming.	7L
IV	**Memory:** Basic concept and hierarchy, semiconductor RAM memories, 2D & 2 1/2D memory organization, ROM memories, Cache memories: concept, design issues & performance, address mapping, Auxiliary memories: magnetic disk, magnetic tape and optical disks, Virtual memory: concept and implementation.	7L

Text Books:

1. *John P. Hayes, Computer Architecture and Organization, Tata Mc Graw Hill, Third Edition,1998.Reference books*
2. *William Stallings, Computer Organization and Architecture-Designing for Performance, Pearson Education, Seventh edition, 2006.*
3. *Computer system architecture by M. Morris Mano,Third edition*

Reference Books:

1. *Behrooz Parahami, "Computer Architecture", Oxford University Press, Eighth Impression,2011.*
2. *David A. Patterson and John L. Hennessy, "Computer Architecture-A Quantitative Approach", Elsevier, a division of reed India Private Limited, Fifth edition, 2012.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	10
2) Presentations /Seminar	NA
3) Assignments	05
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	35
Total:	**50**

Prerequisites for the course: NA

Course Learning Outcomes:

CO-1	Study of the basic structure and operation of a digital computer system.	**L1& L2**
CO-2	Analysis of the design of arithmetic & logic unit and understanding of the fixed point and floating-point arithmetic operations.	**L1 & L2**
CO-3	Implementation of control unit techniques and the concept of Pipelining	**L1 & L2**
CO-4	Understanding the hierarchical memory system, cache memories and virtual memory	**L2 & L3**
CO-5	Understanding the different ways of communicating with I/O devices and standard I/O interfaces	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Computer Organization and Architecture(RSCS-231)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	2	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech. (AI-ML)**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Operating System Lab**
Course Code: RTCS-231P	**Title: Operating System Lab**

Course Objectives:
1. To learn shell programming and the use of filters in the LINUX environment.
2. To practice multithreaded programming.
3. To implement CPU Scheduling Algorithms and memory management algorithms.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 3	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Write C programs to simulate the following CPU scheduling algorithms. a) FCFS b) SJF c) Round Robin d) Priority.
Practical-2.	Write a C program to simulate producer-consumer problem using Semaphores.
Practical-3.	Write a C program to simulate the concept of Dining-philosophers problem.
Practical-4.	Write a C program to simulate the following contiguous memory allocation Techniques a) Worst fit b) Best fit c) First fit.
Practical-5.	Write C programs to simulate all page replacement algorithms a)FIFO b) LRU c) OPTIMAL
Practical-6.	Write C programs to simulate all File Organization Techniques a) Single level directory b) Two level directory
Practical-7.	Write a C program to simulate all file allocation strategies a) Sequential b) Indexed c) Linked.
Practical-8.	Write a C program to simulate Bankers Algorithm for Deadlock Avoidance.
Practical-9.	Write a C program to simulate Bankers Algorithm for Dead Lock Prevention.
Practical-10.	Write a C program to simulate disk scheduling algorithms. a) FCFS b) SCAN c) C-SCAN

Reference/Text Books:
1. R. Kruse etal, "Data Structures and Program Design in C", Pearson Education.
2. Berztiss, AT: Data structures, Theory and Practice, Academic Press.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	**Implement basic operating system functionalities** such as process creation, scheduling, memory allocation, and file handling through programs in C or equivalent programming language.	**L3 & L4**
CO-2	**Simulate CPU scheduling algorithms** (FCFS, SJF, Priority, Round Robin) and analyze their performance in terms of waiting time and turnaround time.	**L4**
CO-3	**Develop programs to handle process synchronization** using semaphores, mutexes, and implement classic problems such as Producer-Consumer, Reader-Writer, and Dining Philosophers.	**L3**
CO-4	**Demonstrate memory management techniques** such as paging, segmentation, and page replacement algorithms.	**L3 & L4**
CO-5	**Apply system calls for process and file management** to gain familiarity with UNIX/Linux OS environments.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Operating System Lab (RTCS-231P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	2	0	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	2	2	1	0	0	0	0	0	0	2	2
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Digital Logic System Lab**
Course Code: RTCS-232P	**Title: Digital Logic System Lab**

Course Objectives:

1. Students will be able to analyze and do some simple design of combinational logic.
2. Students will examine the various logic gates and circuits in the laboratory. They will design, build and troubleshoot logic circuits in the laboratory.
3. Students will be able to analyze and do some simple design of sequential logic. They will be familiar with and incorporate into circuits the latches, flip-flops, and counters.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 3	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1	Introduction to digital electronics lab- verification of the truth tables of logic gates.
Practical-2	Design and implementation of Adder and Sub-tractor using logic gates.
Practical-3	Design and implementation of 2 bit Magnitude Comparator using logic gates.
Practical-4	Design and implementation of Decoder using logic gates.
Practical-5	Design and implementation of Encoder using logic gates.
Practical-6	Design and implementation of Multiplexer using logic gates.
Practical-7	Design and implementation of De-multiplexer using logic gates.
Practical-8	Verification of state tables of RS, JK, T and D flip-flops using NAND gates.
Practical-9	Construction and verification of shift registers.
Practical-10	Design, and verify the 4-bit synchronous counter.

Reference/Text Books:

1. M. Morris Mano and M. D. Ciletti, “Digital Design”, Pearson Education.
2. David J. Comer, “Digital Logic & State Machine Design”, Oxford University Press.

Reference Books:

1. RP Jain, “Modern Digital Electronics”, Tata McGraw Hill Publication.
2. Charles H Roth (Jr), Larry L. Kinney, “Fundamentals of Logic Design”, Cengage Learning India Edition, 5th Edition, 2010.

Evaluation/Assessment Methodology		
Category	**Internal/External**	**Max. Marks**
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:		
CO-1	Understand the Digital Binary System and implementation of Gates.	
CO-2	Understand and design combinational and sequential systems.	
CO-3	Design the counters with the help of sequential circuit and basic Gates.	
CO-4	Understand concepts of digital integrated circuits.	
CO-5	Implement the projects using the digital ICs and electronics components.	

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Digital Logic System Lab (RTCS-232P)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	1	2	0	0	0	0	1	0	2
CO-2	3	3	2	1	2	0	0	0	0	1	0	2
CO-3	3	3	2	2	2	0	0	0	0	1	0	2
CO-4	3	3	2	1	2	0	0	0	0	1	0	2
CO-5	3	3	2	2	2	0	0	0	0	1	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Theory of Computation Lab**
Course Code: RTCS-233P	**Title: Theory of Computation Lab**

Course Objectives:
1. Demonstrate the concept of Finite Automata and Regular Expression.
2. Demonstrate the designing of Finite Automata.
3. Design the grammar for respective language.
4. Demonstrate the designing of Push Down Automata.
5. Demonstrate the designing of Turing Machine

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 3	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Understanding of software like JFLAP (Java Formal Languages and AutomataPackage) for experimenting with formal languages
Practical-2.	Deterministic Finite Automata (DFA)
Practical-3.	Nondeterministic Finite Automata (NFA)
Practical-4.	Conversion of NFA to DFA
Practical-5.	DFA Minimization
Practical-6.	DFA to regular grammar conversion
Practical-7.	DFA to regular expression conversion
Practical-8.	Combining automata
Practical-9.	Regular expression to DFA conversion
Practical-10.	Mealy and Moore machine

Reference/Text Books:
1. Introduction to Automata theory, Languages and Computation, J.E. Hopcraft, R. Motwani, and Ullman. 2nd edition, Pearson Education Asia.

Evaluation/Assessment Methodology		
Category	**Internal/External**	**Max. Marks**
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:		
CO-1	Demonstrate the concept of Finite Automata and Regular Expression.	**L2 & L3**
CO-2	Demonstrate the designing of Finite Automata.	**L2**
CO-3	Design the grammar for respective language.	**L3**
CO-4	Demonstrate the designing of Push Down Automata.	**L3**
CO-5	Demonstrate the designing of Turing Machine.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Theory of Computation Lab (RTCS-233P)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	2	2	0	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	2	2	1	0	0	0	0	0	0	2	2
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Advance Python Programming Lab**
Course Code: RSCS-232P	**Title: Advance Python Programming Lab**

Course Objectives:
1. To develop proficiency in advanced Python programming constructs.
2. To apply object-oriented programming principles.
3. To implement robust exception handling techniques.
4. To use Python libraries such as NumPy and Pandas.
5. To create applications that interact with files and databases.

Nature of Paper : AECC

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 3	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Write a program to demonstrate the set functions and operations.
Practical-2.	i) Write a program to input numbers from the user and store these numbers in a tuple. Print the maximum and minimum number from this tuple. ii) Create a user-defined function that prints a tuple whose values are the cube of a number between 1 and n (both included), where n is an integer number and passed as an argument.
Practical-3.	i) Write a program to count the number of times a character appears Ingiven string using a dictionary. ii) Write a user-defined function to convert a number entered by the user into its corresponding number in words. For example, if the input is 789 then the output should be 'Seven Eight Nine'.
Practical-4.	Write a program to define a module to find the area and circumference of a circle. i) Import the module to another program. ii) Import a specific function from a module to another program
Practical-5.	Create a package named Demo Package which contains two modules named mathematics and greets. The mathematics module contains sum, average, power functions, and the greets module contains the say Hello function. i) Import the module from a package to another program. ii) Import a specific function from a module.

Practical-6.	Write a program to catch on Divide by zero Exception with finally clause.
Practical-7.	Write a user-defined exception that could be raised when the text entered by a user consists of less than 10 characters.
Practical-8.	Write a python program to demonstrate exception handling.
Practical-9.	Write a program to read the content of a file line by line and write it to another file except for the lines containing "a" letter in it.
Practical-10	Write a program that inputs a text file. The program should print all unique words in the file in alphabetical order.

Reference/Text Books:

1. Martin C. Brown (Author), "Python: The Complete Reference" McGraw Hill Education, Fourth edition, 2018.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Develop Module(s) and Package(s) in python.	**L3**
CO-2	Implement Object Oriented concepts in programming.	**L3**
CO-3	Apply exception handling and user defined exception(s).	**L3**
CO-4	Make use of Pandas and Numpy Libraries.	**L3**
CO-5	Apply Collection modules for the data types.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Advance Python Programming Lab (RSCS-232P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	2	0	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	2	2	1	0	0	0	0	0	0	2	2
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Introduction to A.I.**
Course Code: RESE-233	**Title: Introduction to A.I.**

Course Objectives:

1. Understand the various characteristics of Intelligent agents.
2. Learn the different search strategies in AI.
3. Learn to represent knowledge in solving AI problems.
4. Understand the different ways of designing software agents and know about the various applications of AI.
5. To develop semantic-based and context-aware systems to acquire, organize process, share and use the knowledge embedded in multimedia content.

Nature of Paper: Engineering Science Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit (4 Hrs./Week = 4 Credits)

Unit	Contents	No. of Lectures Allotted
I	AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.	9L
II	**Introduction to Search:** Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games, Alpha - Beta pruning.	9L
III	**Knowledge Representation & Reasoning:** Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks	9L
IV	**Planning and Learning:** Planning with state space search, conditional planning, continuous planning, Multi-Agent planning. Forms of learning, Inductive Learning, Statistical learning method and Reinforcement learning.	9L
V	**Expert systems:-** Introduction, basic concepts, structure of expert systems, the human element in expert systems how expert systems works, problem areas addressed by expert systems, expert systems success factors, types of expert systems, expert systems and the internet interacts web, knowledge engineering, scope of knowledge, difficulties, in knowledge acquisition	9L

	methods of knowledge acquisition, machine learning, intelligent agents, selecting an appropriate knowledge acquisition method, societal impacts reasoning in artificial intelligence, inference with rules, with frames: model based reasoning, case based reasoning, explanation & meta knowledge inference with uncertainty representing uncertainty.	

Text Books:

1. *S. Russel and P. Norvig, "Artificial Intelligence – A Modern Approach", SecondEdition, Pearson Education.*
2. *David Poole, Alan Mackworth, Randy Goebel, "Computational Intelligence : a logical approach", Oxford University Press.*

Reference Books:

1. *G. Luger, "Artificial Intelligence: Structures and Strategies for complex problemsolving", Fourth Edition, Pearson Education.*
2. *J. Nilsson, "Artificial Intelligence: A new Synthesis", Elsevier Publishers.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Build intelligent agents for search and games.	**L3**
CO-2	Solve AI problems through programming with Python.	**L2& L3**
CO-3	Learn optimization and inference algorithms for model learning.	**L2 & L3**
CO-4	Design and develop programs for an agent to learn and act in a structured environment.	**L3& L4**
CO-5	Possess the ability to apply AI techniques to solve problems of Game Playing, Expert Systems andmachine learning.	**L3& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Introduction to A.I. (RESE-233)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Soft Computing**
Course Code: RESE-234	**Title: Soft Computing**

Course Objectives:
1. To introduce the concept of soft computing.
2. To acquaint the concept of Fuzzy System.
3. To understand the concepts of Neuro-fuzzy Modeling.
4. To introduce the concept of genetic algorithms.
5. To understand the applications of soft computing and to introduction MATLAB Environment.

Nature of Paper: Engineering Science Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to Soft Computing, ARTIFICIAL NEURAL NETWORKS Basic concepts - Single layer perception - Multilayer Perception - Supervised and Unsupervised learning – Back propagation networks - Kohnen's self-organizing networks - Hopfield network.	9L
II	FUZZY SYSTEMS Fuzzy sets, Fuzzy Relations and Fuzzy reasoning, Fuzzy functions - Decomposition - Fuzzy automata and languages - Fuzzy control methods - Fuzzy decision making.	9L
III	NEURO - FUZZY MODELING Adaptive networks based Fuzzy interface systems - Classification and Regression Trees - Data clustering algorithms - Rule based structure identification - Neuro-Fuzzy controls - Simulated annealing – Evolutionary computation	9L
IV	GENETIC ALGORITHMS Survival of the Fittest - Fitness Computations - Cross over - Mutation - Reproduction - Rank method - Rank space method	9L
V	APPLICATION OF SOFT COMPUTING Optimization of traveling salesman problem using Genetic Algorithm, Genetic algorithm based Internet Search Techniques, Soft computing based hybrid fuzzy controller, Introduction to MATLAB Environment for Soft computing Techniques.	9L

Text Books:
1. *An Introduction to Genetic Algorithm Melanic Mitchell (MIT Press)*
2. *Evolutionary Algorithm for Solving Multi-objective, Optimization Problems (2nd Edition), Collelo, Lament, Veldhnizer (Springer)*

3. Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley)

Reference Books:

1. Neural Networks and Learning Machines Simon Haykin (PHI)
2. Sivanandam, Deepa, " Principles of Soft Computing", Wiley

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Fuzzy Logic

Course Learning Outcomes:

CO-1	To memorize and understand the concept of soft computing.	**L2 & L3**
CO-2	To understand the fundamentals of Neuro-fuzzy Modeling	**L3 &L4**
CO-3	To understand the concept of genetic algorithms.	**L1& L3**
CO-4	To understand the concept of genetic algorithm based Internet Search Techniques.	**L2 & L3**
CO-5	To memorize and understand the concept of applications of soft computing	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Soft Computing (RESE-234)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	1	0	2	2	2
CO-2	1	3	2	3	2	1	0	2	0	2	1	2
CO-3	2	2	0	1	1	0	0	1	0	3	1	2
CO-4	3	1	2	3	2	1	0	1	0	2	1	1
CO-5	2	2	2	2	2	1	0	3	0	3	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Engineering Mathematics-III**
Course Code RTAS-241	**Title: Engineering Mathematics-III**

Course Objectives:
1. To make the students familiar with complex functions and its calculus.
2. To deal with applications, residues and conformal mapping.
3. To understand the concept and applications of integral transforms.
4. To deal with numerical solutions of algebraic equations and differential equations.
5. To understand the statistical aspect of functions.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Functions of a Complex Variable I**: Analytic functions; C-R equations and harmonic functions; Line integral in the complex plane; Cauchy's integral theorem, Cauchy's integral formula for derivatives of analytic functions; Liouvilles theorem.	9L
II	**Functions of a Complex Variable II**: Representation of a function by power series; Taylor's and Laurent's series; Singularities, zeroes and poles; Residue theorem, evaluation of real integrals; conformal mapping and bilinear transformations.	9L
III	**Integral Transforms:** Fourier integral, Fourier complex transform, Fourier sine and cosine transforms and applications to simple heat transfer equations. Z – Transform and its application to solve difference equations.	9L
IV	**Numerical Techniques:** Solution of polynomial and transcendental equations Bisection method, Regula R – Falsi method, Newton - Raphson method. **Interpolation:** Finite difference, Newton's forward and backward interpolation, Lagrange's and Newton's divided difference formula for unequal intervals; **Numerical Differentiation**, **Numerical Integration**; Trapezoidal, Simpson's 1/3 and 3/8 rules. **Numerical solutions of first order differential equations** by Euler's method and 4th order Runge-Kuttamethod.	9L
V	**Statistical Techniques:** Moments, Moment generating functions, Skewness, Kurtosis, CurveFitting and Solution of Equations: Method of least squares and	9L

	curve fitting of straight line and parabola, Correlation and Regression, Binomial distribution, Poisson distribution, Normal distribution.	

Text Books:

1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*

Reference Books:

1. *E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.*
2. *R K. Jain & S R K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House 2002.*
3. *Veerarajan T., Engineering Mathematics for first year, McGraw-Hill, New Delhi, 2008.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Engineering Mathematics-I(SEAS-111) & Engineering Mathematics-II(SEAS-121)

Course Learning Outcomes:

CO-1	Understand and check the Analyticity of a complex function.	**L2 & L3**
CO-2	To apply the concept of Analytic functions in residue and conformal mappings.	**L3 &L4**
CO-3	To solve and apply the concepts of transforms in the area of engineering.	**L1& L3**
CO-4	To solve numerically the Algebraic equations, Differential equations, and to differentiate & integrate numerically.	**L2**
CO-5	To understand and use the concept of statistical tools to analyze the different data.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Engineering Mathematics-III (RTAS-241)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	2	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Java Programming**
Course Code: RTCS-241	**Title: Java Programming**

Course Objectives:
1. Understand Object Oriented Programming concepts and basic characteristics of Java.
2. Know the principles of packages, inheritance, and interfaces.
3. Define exceptions and use I/O streams.
4. To understand how to connect to the database using JDBC.
5. To understand the design of Graphical User Interface using applets and swing controls.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Java Basics and Inheritance: The Genesis of Java, Overview of Java, Data Types, Variables, and Arrays, Operators, Control Statements, Introducing Classes, Methods and Classes,Type Casting, String Handling, Abstract Class, Method overriding. Inheritance: Basics, Using Super, Creating a Multilevel Hierarchy, Problem with Multiple Inheritance.	9L
II	Packages, Interfaces and Exception Handling: Packages- Packages, Access Protection, Importing Packages, Interfaces- Definition and Implementations, Exception Handling- Types, Try and Catch, Throw and Finally statements. advanced topics in exception handling, such as creating custom exceptions and handling multiple exceptions.	9L
III	Multi-Threading and File Handling: Multithreaded Programming, Thread Life Cycle Creating Threads, Creating Multiple Threads, Thread Priorities, Synchronization, Inter Thread Communication, Suspending, Resuming and Stopping Threads. File Handling: I/O Basics, Reading Console Input, Writing Console output, I/ O Classes and Interfaces.	9L
IV	Collection Framework in Java – Introduction to java collections, Overview of java collection framework, commonly used collection classes- Array List, Vector, Hash table, Stack, String to kenizer. Connecting to Database – JDBC Type 1 to 4 drivers, connecting to a database, querying a database and processing the results, updating data with JDBC.	9L

V	Applets – Define applets, differences between applets and applications, Life cycle of an applet, Passing parameters to applets. GUI Programming with Java- The AWT class hierarchy, Introduction to Swing, Swing Vs AWT, Hierarchy for Swing components, Overview of some Swing components – J button, J Label, J Text Field, J Text Area, simple Swing applications, Layout management – Layout manager types – border, grid and flow Event Handling- Events, Event sources, Event classes, Event Listeners, Event sources and Listeners, Delegation event model, Examples: Handling a button click, Handling Mouse events, Adapter classes.	**9L**

Text Books:

1. *Herbert Schildt, —Java The complete reference, 8th Edition, McGraw Hill Education, 2011.*
2. *Cay S. Horstmann, Gary cornell, —Core Java Volume –I Fundamentals, 9th Edition, Prentice Hall, 2013.*

Reference Books:

1. *Paul Deitel, Harvey Deitel, —Java SE 8 for programmers, 3rd Edition, Pearson, 2015.*
2. *Steven Holzner, —Java 2 Black book, Dreamtech press, 2011.*
3. *Timothy Budd, —Understanding Object-oriented programming with Java, Updated Edition, Pearson Education, 2000.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Write Java programs with properly designed constants, variables, objects, methods and reusability functionality.	**L2 & L3**
CO-2	Learn how and where to implement interface and exception-handling concepts.	**L3 &L4**
CO-3	Write multi-threaded programming concepts for concurrency control-based applications.	**L1& L3**
CO-4	Construct GUI based JAVA enterprise applications.	**L2**
CO-5	Develop web applications using JDBC, RMI and Servlet methodologies.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Java Programming (RTCS-241)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	2	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Data Structures using C**
Course Code: RTCS-242	**Data Structures using C**

Course Objectives:

1. Student will be able to describe how arrays, linked lists, stacks, queues, trees, and graphs are represented in memory, used by the algorithms and their common applications.
2. Student will be able to discuss the computational efficiency of the sorting and searching algorithms.
3. Student will be able to implement trees and Graphs and perform various operations on these data structure.
4. Student will be able to understand the concept of recursion, application of recursion and its implementation and removal of recursion.
5. Student will be able to identify the alternative implementations of data structures with respect to its performance to solvereal-world problems.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Basic Terminology, Elementary Data Organization, Built in Data Types available in C. Overview of Algorithms, Efficiency of an Algorithms and its time and s pace c omplexity. Asymptotic notations: Big Oh, Big Theta and Big Omega, Discussion on Time-Space trade-off, Introduction to Abstract Data Types (ADT). **Arrays**: Definition and types: Single and Multidimensional Arrays, Representation of Arrays: Row Major Order, and Column Major Order, Derivation of Index Formulae for 1-D,2-D,3-D and n-D Arrays, Application of arrays, Sparse Matrices and their representations. **Linked lists:** Array Implementation and Pointer Implementation of Singly Linked Lists, Doubly Linked List, Circularly Linked List, Operations on a Linked List. Insertion, Deletion, Traversal, Polynomial Representation and Addition, Subtraction & Multiplications of Single variable &Two variables polynomial.	9L

II	**Stacks:** Abstract Data Type, Primitive Stack operations: Push & Pop, Array and Linked Implementation of Stack in C, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression, Iteration and Recursion-Principles of recursion, Tail recursion, Removal of recursion Problem solving using iteration and recursion with examples such as binary search, Fibonacci numbers, and Hanoi towers. Tradeoffs between iteration and recursion. **Queues:** Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, Array and linked implementation of queues in C, Dequeue and Priority Queue	**9L**
III	**Searching:** Concept of Searching and types of searching: Sequential search, Index Sequential Search, Binary Search. Concept of Hashing & Collision resolution Techniques used in Hashing. **Sorting:** Insertion Sort, Selection, Bubble Sort, Quick Sort, Merge Sort, Heap Sort and Radix Sort.	**9L**
IV	**Graphs:** Terminology used with Graph, Data Structure for Graph representations by using C: Adjacency Matrices and Adjacency List.Graph Traversal: Depth First Search and Breadth First Search, Connected Component, Spanning Trees, Minimum Cost Spanning Trees: Prims and Kruskal algorithm. Transitive Closure and Shortest Path algorithm: Warshal Algorithm and Dijikstra Algorithm.	**9L**
V	**Trees:** Basic terminology used with Tree, Binary Trees, Binary Tree Representation: Array Representation and Pointer (Linked List) Representation, Binary Search Tree, Strictly Binary Tree, Complete Binary tree. Extended Binary Trees, Tree Traversal algorithms: In order, Preorder and Post order, Constructing Binary Tree from given Tree Traversal, Operation of Insertion, Deletion, Searching & Modification of data in Binary Search. Threaded Binary trees, Traversing Threaded Binary trees, Huffman coding using Binary Tree, Concept & Basic Operations for AVL Tree, B Tree & Binary Heaps.	**9L**

Text Books:

1. Lipschutz,"Data Structures"Schaum's Outline Series,Tata McGraw-hillE ducation (India) Pvt. Ltd.
2. A K Sharma,"Data Structure Using C", Pearson Education India.

Reference Books:

1. Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J.Augenstein, "Data Structures Using C and C++", PHI Learning Private Limited, Delhi India.
2. Horowitz and Sahani,"Fundamentals of DataStructures", Galgotia Publications Pvt. Ltd. Delhi India.
3. Thareja,"Data Structure Using C" Oxford Higher Education.
4. Michael T. Goodrich, Roberto Tamassia, David M. Mount "Data Structures and Algorithms in C++", Wiley India.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA

3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Describe how arrays, linked lists, stacks, queues, trees, and graphs are represented in memory, used by the algorithms and their common applications.	**L2 & L3**
CO-2	Discuss the computational efficiency of the sorting and searching algorithms.	**L3 &L4**
CO-3	Implementation of Trees and Graphs and perform various operations on these data structure.	**L1& L3**
CO-4	Understanding the concept of recursion, application of recursion and its implementation and removal of recursion.	**L3**
CO-5	Identify the alternative implementations of data structures with respect to its performance to solve a real-world problem.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Data Structures using C(RTCS-242)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: IV**
Credits: 2 **Theory: 2** **Practical: 0**	**Subject: Indian Ethos and Modern Management**
Course Code: IEMM-402	**Title: Indian Ethos and Modern Management**

Course Objectives:
1. To understand the concept of Indian Ethos in Management
2. To link the Traditional Management System to Modern Management System
3. To understand the Techniques of Stress Management
4. To understand the Evolution of Learning Systems in India
5. To motivate learners to research further on Indian Culture.

Nature of Paper: VAC- 3

Minimum Passing Marks/Credits: 40% Marks / 2 Credits

L : 3	T : 0	P : 0	C : 2

Note: Theory - L:3 T:0 P:3(In Hours/Week)

Unit	Contents	No. of Lectures Allotted
I	Meaning, Features, Need, History, Relevance, Principles Practiced by Indian Companies, Requisites, Elements, Role of Indian Ethos in Managerial Practices, Indian Heritage in Business Management, Ethics v/s Ethos, Indian Vs Western Management.	9
II	**Chankaya's Philosophy – A Way to Personal and Public Victory and Management** Application and Impact of Chanakya's Philosophy in Personal life, Achieving success in professional life with Chankaya, Corporate Chanakya.	9
III	**Management Lessons from Indian Scriptures-I** Management Lessons from Mahabharata, Management lessons from Geeta, Management Lessons from Ramayana **Management Lessons from Indian Scriptures-II** Management Lessons from the Vedas, Management Lessons from the Bible, and Management Lessons from the Quran.	9
IV	**Indian Systems of Learning** Modern System of Learning: Meaning, Features, Advantages, Disadvantages. Karma: Meaning, Importance of Karma to Managers, Nishkama Karma. Laws of Karma: The Great Law, Law of Creation, Law of Humility, Law of Growth, Law of Responsibility, Law of Connection. Corporate Karma: Meaning, Methodology, Guidelines for Good Corporate Karma.	9

	Self-management: Personal Growth and Lessons from Ancient Indian Education System.	
V	Relevance of Value-based & Ethics Based Management in Global Change Developing Code of Culture in Organization, Ethical, and Value-Based Leadership, the impact of Values on stakeholders; Trans-cultural human values; Secular - Vs Spiritual values; value system in work culture.	**9**

Reference / Text Books:

1. "Indian Ethos and Values in Management" by R.C. Sharma
2. "Management and Indian Ethos" by Subhash Sharma
3. "The Bhagavad Gita: A New Commentary for Modern Readers" by Eknath Easwaran
4. "Indian Ethos in Management" by N. M. Khandwalla
5. "Management and the Indian Ethos" by G. P. Rao
6. "Indian Ethos and Values for Managers" by B. L. Bajpai

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NA**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	10
2) Presentations /Seminar	NA
3) Assignments	05
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	35
Total:	**50**

Prerequisites for the course: Probabilistic Modeling and Reasoning with Python Programming basics

Course Learning Outcomes: After completion of the course, the student should be able to:

CO-1	Understand the various elements of Indian ethos and management lessons from Indian scriptures	**L1& L2**
CO-2	Know the work ethos and values and its relevance management.	**L2 & L3**
CO-3	Deal with varied ethical dilemma at workplace and explore the impact of moral philosophies in ethical decision making	**L3& L2**
CO-4	Explore the significance of Value Education and Service Learning and ways to promote peace and harmony	**L2, L3 & L4**
CO-5	Recognize the core human values for shaping an individual's personality, external behavior and internal sense of wellbeing	**L1& L2**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Indian Ethos and Modern Management (IEMM-402)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	3	2	2	2	2	0	0	0	0	2
CO-2	2	3	2	3	3	1	1	0	0	0	0	2
CO-3	3	3	3	3	2	2	2	0	1	0	0	1
CO-4	3	3	3	2	2	2	2	0	0	0	0	1
CO-5	3	3	2	2	2	2	2	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: OOPs**
Course Code: RDCS-241	**Title: OOPs**

Course Objectives:

1. Provide flexible and powerful abstraction.
2. Allow programmers to think the problem in terms of the structure rather than in terms of structure of the computer.
3. Decompose the problem into a set of objects.
4. Objects interact with each other to solve the problem.
5. Create new type of objects to model elements from the problem space.

Nature of Paper: DSE

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit (4 Hrs./Week = 4 Credits)

Unit	Contents	No. of Lectures Allotted
I	**Principles of Object Oriented Programming** Procedure Oriented Programming (POP) verses Object Oriented Programming (OOP), Features of Object Oriented Programming, Examples of Object Oriented languages, Applications of OOP, Data types, Declaration of variable, Dynamic initialization of variable, Reference variable, Type casting, Basics of object and class in C++, Private and public members, static data and function members. **Special Operators in C++:** Scope resolution operator, Memory management operators, Manipulators, Structure of C++ program, Basic Input /Output operators and functions in C++, Simple C++ Program. **Class & Object:** Introduction, Specifying a class, Access specifiers, Defining member functions: Inside class and Outside class, Creating objects, Memory allocations for object.	9L
II	**Functions and Constructors:** Inline function, Static data members, Static member function, Friend function: Using two different classes, Using non-member function, Array of Objects, Object as function arguments, Concepts of Constructors, Types of constructors, Constructor overloading and Constructors with default arguments, Destructors.	9L
III	**Extending classes using Inheritance**: Introduction to Inheritance, Defining a derived class, Visibility modes and effects, Types of Inheritance: Single, Multilevel, Multiple, Hierarchical, Hybrid, Virtual base class, Abstract class,	9L

	Constructor in derived class	
IV	**Pointers and Polymorphism in C++**: **Concept of Pointer:** Pointer declaration, Pointer operator, Address operator, Pointer arithmetic, Pointer to Object: Pointer to object, 'this' pointer, Pointer to derived class, Introduction of Polymorphism, Types of polymorphism, Compile time Polymorphism: Function overloading, Revision of constructor overloading, Operator overloading: Rules for operator overloading, Overloading of unary and binary operators, Run time polymorphism: Virtual function, Rules for virtual function, Pure virtual function	**9L**
V	**File operations**: C++ stream classes, Classes for file stream operations, Detection of end of file, File modes, Opening files: Using constructors and open(), Closing files, Reading from and writing to files, Formatted Input/output functions in file, Types of file: Random access, Sequential access.	**9L**

Text Books:

1. Object Oriented Programming with C++ by E. Balagurusamy, McGraw-Hill Education (India).
2. ANSI and Turbo C++ by Ashoke N. Kamthane, Pearson Education

Reference Books:

1. C++ and Object Oriented Programming – Jana, PHI Learning.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	**Max. Marks**
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Recognize features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.	**L2**
CO-2	Apply some common object-oriented design patterns.	**L3**
CO-3	Specify simple abstract data types and design implementations using abstraction functions to document them.	**L2 & L3**
CO-4	Design a convenient way for the handling problems using templates and use simple try-catch blocks for Exception Handling.	**L2 &L3**
CO-5	Manage I/O streams and File I/O oriented interactions.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping OOPs with C++ (RDCS-241)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	2	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Data Analytics**
Course Code: RDCS-242	**Title: Data Analytics**

Course Objectives:

1. Student will be able to describe the life cycle phases of Data Analytics through discovery, planning and building.
2. Student will be able to understand and apply Data Analysis Techniques.
3. Student will be able to implement various Data streams
4. Student will be able to understand item sets, Clustering, frame works & Visualizations.
5. Student will be able to apply R tool for developing and evaluating real time applications

Nature of Paper: Discipline Specific Electives (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to Data Analytics: Sources and nature of data, classification of data, characteristics of data, introduction to Big Data platform, need of data analytics, evolution of analytic scalability, analytic process and tools, analysis vs reporting, modern data analytic tools, applications of data analytics. Data Analytics Lifecycle: Need, key roles for successful analytic projects, various phases of data analytics lifecycle – discovery, data preparation, model planning, model building, communicating results, and operationalization.	**9L**
II	Data Analysis: Regression modeling, multivariate analysis, Bayesian modeling, inference and Bayesian networks, support vector and kernel methods, analysis of time series: linear systems analysis & nonlinear dynamics, rule induction, neural networks: learning and generalisation, competitive learning, principal component analysis and neural networks, fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, stochastic search methods.	**9L**
III	Mining Data Streams: Introduction to streams concepts, stream data model and architecture, stream computing, sampling data in a stream, filtering streams, counting distinct elements in a stream, estimating moments, counting oneness in a window, decaying window, Real-time Analytics Platform (RTAP) applications, Case studies – real time sentiment analysis, stock market predictions	**9L**

IV	Frequent Item sets and Clustering: Mining frequent item sets, market based modelling, Apriori algorithm, handling large data sets in main memory, limited pass algorithm, counting frequent item sets in a stream, clustering techniques: hierarchical, K-means, clustering high dimensional data, CLIQUE and ProCLUS, frequent pattern based clustering methods, clustering in non-euclidean space, clustering for streams and parallelism.	**9L**
V	Frame Works and Visualization: Map Reduce, Hadoop, Pig, Hive, H Base, Map R, Sharding, No SQL Databases, S3, Hadoop Distributed File Systems, Visualization: visual data analysis techniques, interaction techniques, systems and applications. Introduction to R - R graphical user interfaces, data import and export, attribute and data types, descriptive statistics, exploratory data analysis, visualization before analysis, analytics for unstructured data.	**9L**

Text Books:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer
2. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press.

Reference Books:

1. Bill Franks, Taming the Big Data Tidal wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, John Wiley & Sons.
2. John Garrett, Data Analytics for IT Networks: Developing Innovative Use Cases, Pearson Education

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Describe the life cycle phases of Data Analytics through discovery, planning and building.	**L2**
CO-2	Understand and apply Data Analysis Techniques.	**L2 &L3**
CO-3	Implement various Data streams.	**L3**
CO-4	Understand item sets, Clustering, frame works & Visualizations.	**L3**
CO-5	Apply R tool for developing and evaluating real time applications.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Data Analytics (RDCS-242)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	3	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	2	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Distributed System**
Course Code: RDCS-243	**Title: Distributed System**

Course Objectives:

1. Understand the foundations of distributed systems.
2. Learn clock synchronization issues and the need for global state in distributed systems.
3. Learn distributed mutual exclusion and deadlock detection algorithms.
4. Understand the significance of agreement, fault tolerance and recovery protocols in Distributed Systems.
5. Learn the characteristics of peer-to-peer and distributed shared memory systems.

Nature of Paper: DSE

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Distributed Environment:** Introduction, Limitations, Remote Procedure Call, Remote Object Invocation, Message-Oriented Communication, Unicasting, Multicasting and Broadcasting, Group Communication.	9L
II	**Distributed Operating Systems:** Issues in Distributed Operating Systems, Threads in Distributed Systems, Clock Synchronization, Causal Ordering, Global States, Election Algorithms, Distributed Mutual Exclusion, Distributed Deadlock, Agreement Protocols	9L
III	**Distributed Resource Management:** Distributed Shared Memory, Data-Centric Consistency Models, Client-Centric Consistency Models, Distributed File Systems, Sun NFS.	9L
IV	**Distributed Transaction Processing:** Transactions, Nested Transactions, Locks, Optimistic Concurrency Control, Timestamp Ordering, Comparison, Flat and Nested Distributed Transactions, Atomic Commit Protocols, Concurrency Control in Distributed Transactions, Distributed Deadlocks, Transaction Recovery, Overview of Replication and Distributed Multimedia Systems.	9L
V	**Fault Tolerance and Consensus:** Introduction to Fault Tolerance, Distributed Commit Protocols, Byzantine Fault Tolerance, Impossibilities in Fault Tolerance.	9L

Text Books/Reference Books::

1. A.S. Tanenbaum, M.Van Steen, "Distributed Systems", Pearson Education, 2007.
2. Mukesh Singhal, Niranjan G.Shivaratri "Advanced Concepts in Operating Systems", Mc Graw Hill Series in Computer Science, 2011.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Acquire the theoretical and conceptual foundations of distributed computing.	**L2**
CO-2	Conceptualize the ideas of distributed operating systems and their issues.	**L2**
CO-3	Understand the issues involved in distributed resource environment.	**L3**
CO-4	Realize the importance of transaction and how to recovery the system from deadlocks.	**L2 & L3**
CO-5	Explore the principles of fault tolerance and its protocols.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Distributed System (RDCS-243)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	3	2	2	2	1	0	0	0	0	2	2
CO-2	2	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	3	2	3	1	0	0	0	0	0	1	2
CO-4	2	3	2	3	2	1	0	0	0	0	1	1
CO-5	2	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Basics of IoT**
Course Code: RDCS-244	**Title: Basics of IoT**

Course Objectives:

1. Vision and introduction to IOT.
2. Understand IOT market perspective.
3. Data and knowledge management and use of devices in IOT technology.
4. Understand the State of the art-IOT Architecture.
5. Understand real world IoT design, constraints, IoT Automation and Commercial building automation in IoT.

Nature of Paper: DSE (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	IoT Definition, IoT Characteristics, IoT Applications, Key Components of IoT System Things/Device, Gateway, Cloud/Server, Analytics, User Interface, Architecture of IoT, IoT Challenges.	9L
II	Voltage Considerations for Sensors, Sensors (working) PIR Motion Sensor, Sharp IR Distance Sensor, LDR Sensor, Gyro Sensor, Ultrasonic Distance Sensor, DHT Sensor, Need of ADC Chip while using Analog Sensors, Actuators (working), Need of Relay while using Actuators.	9L
III	ARDUINO UNO board Block diagram, Sketch Structure, Data types & Built in Constants, Operators: Arithmetic, Bitwise, Compound, Comparison, and Boolean, Control statements and Loops, Functions and library functions, LED Blinking using Arduino, Serial Communication Functions: Serial, available, begin, end, print, println, write, read, read Bytes, read String.	9L
IV	Messaging Protocols: MQTT, CoAP, XMPP, Transport Protocols: Introduction of BLE, Introduction to Li-Fi, Basics of Sensor Network Topologies: Point to Point Topology, Mesh topology, Ring topology, Star Topology	9L
V	Overview, Block Diagram and Working of the following real world IoT applications: Smart Home automation, Agricultural System, Smart Parking.	9L

Text Books:

1. *Internet of Things, Vasudevan, Nagrajan and Sundaram, Wiley India.*
2. *IoT Fundamentals, David Hence at el, Cisco Press*

Reference Books:

1. *Francis da Costa, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", Apress Publications 2013, 1st Edition.*
2. *Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice", Wiley 2014.*
3. *Cuno P fister, "Getting Started with the Internet of Things", O"Reilly Media 2011.* Mukherjee, Fundamentals of Computer graphics & Multimedia, PHI Learning Private Limited.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Demonstrate the architecture and functioning of IoT systems including the sensors and microcontrollers with their interfacing and software need considering application areas.	**L1& L2**
CO-2	Diagnose the various IoT protocols with detailing of their elements and overall functioning within IoT systems for efficient communication.	**L1 & L2**
CO-3	Design an IoT system to take the benefit of the Clouds for computing and storage considering security issues.	**L1 & L2**
CO-4	Leverage the benefits of IoT technologies for automating the various real-life challenges in various application areas.	**L2 & L3**
CO-5	Develop the software components of IoT system using Arduino/Raspberry Pi Programming.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Basics of IoT (RDCS-244)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	3	2	1	0	0	0	0	2	1
CO-2	2	3	2	3	1	1	0	0	0	0	1	2
CO-3	2	3	2	3	2	0	0	0	0	0	1	1
CO-4	3	2	2	3	2	1	0	0	0	0	1	2
CO-5	2	3	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: IV**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Java Programming Lab**
Course Code: RTCS-241P	**Title: Java Programming Lab**

Course Objectives:

1. To introduce the fundamentals of object-oriented programming (OOP) using Java.
2. To enable students to write, compile, and execute Java programs that demonstrate the use of classes, objects, and constructors.
3. To develop problem-solving skills by applying OOP concepts such as inheritance, polymorphism, and exception handling.
4. To familiarize students with Java's built-in classes and packages.
5. To provide hands-on experience in developing GUI-based applications and multithreaded programs using Java.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 3	C :2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Write a java program to find the Fibonacci series using recursive and non-recursive functions.
Practical-2.	Write a java program for Method overloading and Constructor overloading.
Practical-3.	Write a java program to implement Interface using extends keyword.
Practical-4.	Write a java program to create user defined package.
Practical-5.	Develop a Library application using multiple inheritances. Consider Book, Magazines and Journals as base classes and Library as derived class. In the Book class, perform the operations like Search Book, Issue Book, Return Book, Renew Book, and Fine Calculation. In the Magazines and Journals classes, perform issue and return operations.
Practical-6.	Develop a program for banking application with exception handling. Handle the exceptions in following cases: a) Account balance. b) Withdrawal amount is greater than balance amount. c) Transaction count exceeds 3. d) One day transaction exceeds 1 lakh.

Practical-7.	Create a student database and store the details of the students in a table. Perform the SELECT, INSERT, UPDATE and DELETE operations using JDBC connectivity.
Practical-8.	Design a login page using servlets and validate the username and password by comparing the details stored in the database.
Practical-9.	Mini project (Anyone) (Front End: Java, Back End: Oracle, define classes for the application and assign responsibilities) a) Central Library OPAC Engine b) ATM Banking c) Online Shopping d) E-Ticketing System e) Student Information Management System f) City Info Browser g) E-mail Server

Reference/Text Books:

1. *Herbert Schildt, —Java The complete reference, 8th Edition, McGraw Hill Education, 2011.*
2. *Cay S. Horstmann, Gary cornell, —Core Java Volume –I Fundamentals, 9th Edition, Prentice Hall, 2013.*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Apply object-oriented programming principles to solve real-world problems using Java.	**L3**
CO-2	Implement class structures, methods, and constructors to develop reusable code.	**L3**
CO-3	Demonstrate the use of inheritance, polymorphism, and interfaces to design flexible and extensible programs.	**L3**
CO-4	Handle run-time errors and exceptions in Java applications.	**L3 & L4**
CO-5	Develop programs using Java APIs for file handling, multithreading, and basic networking.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Java Programming Lab(RTCS-241P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	2	0	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	2	2	1	0	0	0	0	0	0	2	2
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: IV**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Data Structures using C Lab**
Course Code: RTCS-242P	**Title: Data Structures using C Lab**

Course Objectives:
1. To write and execute programs in C to solve problems using data structures such as arrays, linked lists, stacks, queues.
2. To write and execute programs in C to solve problems using data structures such as trees, graphs, hash tables and search trees.
3. To write and execute write programs in C to implement various sorting and searching methods.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Implementation of Stack using Array.
Practical-2.	Implementation of Queue using Array.
Practical-3.	Implementation of Circular Queue using Array.
Practical-4.	Implementation of Stack using Linked List.
Practical-5.	Implementation of Queue using Linked List.
Practical-6.	Implementation of Circular Queue using Linked List.
Practical-7.	Write a program that implements the following i) Insertion sort ii) Merge sort iii) Heap sort.
Practical-8.	Write a program that implements the following sorting i) Bubble sort ii) Selection sort iii) Quick sort.
Practical-9.	Implementation of Tree Structures, Binary Tree, Tree Traversal, Binary Search BST Tree, Insertion and Deletion in BST.
Practical-10.	Graph Implementation, BFS, DFS, Minimum cost spanning tree, shortest path algorithm.

Reference/Text Books:
1. R. Kruse etal, "Data Structures and Program Design in C", Pearson Education.
2. Berztiss, AT: Data structures, Theory and Practice, Academic Press.

Evaluation/Assessment Methodology		
Category	**Internal/External**	**Max. Marks**
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Be able to design and analyze the time and space efficiency of the data structure.	**L3 & L4**
CO-2	Be capable to identity the appropriate data structure for given problem.	**L4**
CO-3	Have practical knowledge on the applications of data structures.	**L3**
CO-4	Be able to Implement Stack using Array.	**L3 & L4**
CO-5	Be able to Implement Tree Structures, Binary Tree, Tree Traversal, Binary Search BST Tree, Insertion and Deletion in BST.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Data Structures using C Lab (RTCS-242P)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	2	2	0	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	2	2	1	0	0	0	0	0	0	2	2
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: IV

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: IV**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: OOPs with C++ Lab**
Course Code: RTCS-243P	**Title: OOPs with C++ Lab**

Course Objectives:
1. Build software development skills using C++programming for real-world applications.
2. Understand and apply the concepts of classes, packages, interfaces, List, exception handling and file processing.
3. Decompose the problem into a set of objects.
4. Develop applications using event handling.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 3	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Design C++ classes with static members, methods with default arguments, and friend functions. (For example, design matrix and vector classes with static allocation, and a friend function to do matrix-vector multiplication).
Practical-2.	Implement Matrix class with dynamic memory allocation and necessary methods. Give proper constructor, destructor, copy constructor, and overloading of the assignment operator.
Practical-3.	Implement complex number class with necessary operator overloading and type conversions such as integer to complex, double to complex, complex to double etc.
Practical-4.	Overload the new and delete operators to provide a custom dynamic allocation of memory.
Practical-5.	Develop C++ class hierarchy for various types of inheritances.
Practical-6.	Design a simple test application to demonstrate dynamic polymorphism and RTTI.
Practical-7.	Develop a template of the linked-list class and its methods.
Practical-8.	Develop templates of standard sorting algorithms such as bubble sort, insertion sort and quick sort.
Practical-9.	Write a program to raise an exception if any attempt is made to refer to an element whose index is beyond the array size.
Practical-10.	Write a program to read the class object of student info such as name , age ,sex ,height and weight from the keyboard and to store them on a specified file using read() and

	write() functions. Again the same file is opened for reading and displaying the contents of the file on the screen.

Reference/Text Books:

1. Object Oriented Programming with C++ by E. Balagurusamy, Mc Graw-Hill Education (India).
2. ANSI and Turbo C++ by Ashoke N. Kamthane, Pearson Education.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Develop program to illustrate basic concept of OOP features and C++ concept	**L3**
CO-2	Write program to implement concept of inheritance and polymorphism.	**L3**
CO-3	Create program to implement concept of abstract class and virtual functions L	**L3**
CO-4	Develop and implement program using exception handling and templates.	**L3 & L4**
CO-5	Develop program using console I/O and file I/O.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
OOPs with C++ Lab (RTCS-243P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	2	0	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	2	2	1	0	0	0	0	0	0	2	2
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Introduction to AI**
Course Code: RESE-243	**Title: Introduction to AI**

Course Objectives:
1. Understand the various characteristics of Intelligent agents.
2. Learn the different search strategies in AI.
3. Learn to represent knowledge in solving AI problems.
4. Understand the different ways of designing software agents and know about the various applications of AI.
5. To develop semantic-based and context-aware systems to acquire, organize process, share and use the knowledge embedded in multimedia content.

Nature of Paper: Engineering Science Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.	9L
II	**Introduction to Search:** Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games, Alpha - Beta pruning.	9L
III	**Knowledge Representation & Reasoning:** Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks	9L
IV	**Planning and Learning:** Planning with state space search, conditional planning, continuous planning, Multi-Agent planning. Forms of learning, Inductive Learning, Statistical learning method and Reinforcement learning.	9L
V	**Expert systems:-** Introduction, basic concepts, structure of expert systems, the human element in expert systems how expert systems works, problem areas addressed by expert systems, expert systems success factors, types of expert systems, expert systems and the internet interacts web, knowledge engineering, scope of knowledge, difficulties, in knowledge acquisition methods of knowledge acquisition, machine learning, intelligent agents, selecting an appropriate knowledge acquisition method, societal impacts	9L

	reasoning in artificial intelligence, inference with rules, with frames: model based reasoning, case based reasoning, explanation & meta knowledge inference with uncertainty representing uncertainty.	

Text Books:

1. *S. Russel and P. Norvig, "Artificial Intelligence – A Modern Approach", Second Edition, Pearson Education.*
2. *David Poole, Alan Mackworth, Randy Goebel, "Computational Intelligence: a logical approach", Oxford University Press.*

Reference Books:

1. *G. Luger, "Artificial Intelligence: Structures and Strategies for complex problem solving", Fourth Edition, Pearson Education.*
2. *J. Nilsson, "Artificial Intelligence: A new Synthesis", Elsevier Publishers.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Build intelligent agents for search and games.	**L3**
CO-2	Solve AI problems through programming with Python.	**L2 & L3**
CO-3	Learn optimization and inference algorithms for model learning.	**L2 & L3**
CO-4	Design and develop programs for an agent to learn and act in a structured environment.	**L3 & L4**
CO-5	Possess the ability to apply AI techniques to solve problems of Game Playing, Expert Systems and machine learning.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Introduction to A.I. (RESE-243)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech. CSE**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Soft Computing**
Course Code: RESE-244	**Title: Soft Computing**

Course Objectives:

1. To introduce the concept of soft computing.
2. To acquaint the concept of Fuzzy System.
3. To understand the concepts of Neuro-fuzzy Modeling.
4. To introduce the concept of genetic algorithms.
5. To understand the applications of soft computing and to introduction MATLAB Environment.

Nature of Paper: Engineering Science Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Unit	Unit
I	Introduction to Soft Computing, ARTIFICIAL NEURAL NETWORKS Basic concepts - Single layer perception - Multilayer Perception - Supervised and Unsupervised learning – Back propagation networks - Kohnen's self-organizing networks - Hopfield network.	**9L**
II	FUZZY SYSTEMS Fuzzy sets, Fuzzy Relations and Fuzzy reasoning, Fuzzy functions - Decomposition - Fuzzy automata and languages - Fuzzy control methods - Fuzzy decision making.	**9L**
III	NEURO - FUZZY MODELING Adaptive networks based Fuzzy interface systems - Classification and Regression Trees - Data clustering algorithms - Rule based structure identification - Neuro-Fuzzy controls - Simulated annealing – Evolutionary computation	**9L**
IV	GENETIC ALGORITHMS Survival of the Fittest - Fitness Computations - Cross over - Mutation - Reproduction - Rank method - Rank space method	**9L**
V	APPLICATION OF SOFT COMPUTING Optimization of traveling salesman problem using Genetic Algorithm, Genetic algorithm based Internet Search Techniques, Soft computing based hybrid fuzzy controller, Introduction to MATLAB Environment for Soft computing Techniques.	**9L**

Text Books:

1. *An Introduction to Genetic Algorithm Melanic Mitchell (MIT Press).*
2. *Evolutionary Algorithm for Solving Multi-objective, Optimization Problems (2nd Edition), Collelo, Lament, Veldhnizer (Springer).*
3. *Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley).*

Reference Books:

1. *Neural Networks and Learning Machines Simon Haykin (PHI).*
2. *Sivanandam, Deepa, " Principles of Soft Computing", Wiley.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Fuzzy Logic

Course Learning Outcomes:

CO-1	To memorize and understand the concept of soft computing.	**L2 & L3**
CO-2	To understand the fundamentals of Neuro-fuzzy Modeling	**L3 &L4**
CO-3	To understand the concept of genetic algorithms.	**L1& L3**
CO-4	To understand the concept of genetic algorithm based Internet Search Techniques.	**L2 & L3**
CO-5	To memorize and understand the concept of applications of soft computing	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Soft Computing (RESE-244)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	1	0	2	2	2
CO-2	1	3	2	3	2	1	0	2	0	2	1	2
CO-3	2	2	0	1	1	0	0	1	0	3	1	2
CO-4	3	1	2	3	2	1	0	1	0	2	1	1
CO-5	2	2	2	2	2	1	0	3	0	3	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Programme: UG(R) **Class: B-Tech (CSE)**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Introduction to IOT**
Course Code: RESE-235/ RESE-245	**Title: Introduction to IOT**

Course Objectives:
1. To learn the fundamentals of Internet of Things
2. To understand IoT Reference Architecture and basics of IoT protocols
3. To apply the concept of Internet of things in the real world scenario

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION AND APPLICATIONS** Introduction to IoT–Definition, Characteristics, functional requirements, motivation, Physical design-things in IoT, IoT protocols, Logical Design-functional blocks, communication models, Communication APIs, Applications–Home Automation, Cities, Environment, Energy, Agriculture, Health, Industry.	**9L**
II	**M2M AND SYSTEM MANAGEMENT** Introduction-M2M, Difference between M2M and IoT, SDN and NFV for IoT, System Management–need, SNMP, NETCONF, YANG	**9L**
III	**DEVELOPING INTERNET OF THINGS** IoT Methodology-Purpose & Requirements specification, process specification, domain model specification, information model specification, service specification, IoT level specifications.	**9L**
IV	**USAGE OF PYTHON** IoT systems logical design using python-python data types & data structures, control flow, functions or modules, remote access enablement using cloud	**9L**
V	**CASE STUDY ON IoT SYSTEM** Case study for weather monitoring system-modules & package of python, python packages of interest for IoT-JSON, XML, HTTP & URLLib, SMTPLib. Exemplary device-Rasberry pi, Linux on Raspberry pi.	**9L**

Text Books:

1. *Dr. Ovidiu Vermesan and Dr. Peter Friess, Internet of Things: From research and innovation to market deployment, River Publishers 2014.*
2. *Honbo Zhou,"The Internet of Things in the Cloud: A Middleware Perspective" - CRC Press 2012.*
3. *Arshdeep Bahga and Vijay Madisetti, Internet of Things A Hand-on Approach, Universities press, 2015*

Reference Books:

1. *Dieter Uckelmann et.al, Architecting the Internet of Things, Springer, 2011*
2. *Pethuru Raj and Anupama C.Raman, "The Internet of Things: Enabling Technologies and Use Cases, CRC Press*

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B.Tech CSE**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Design and Analysis of Algorithm**
Course Code: SECS-351	**Title: Design and Analysis of Algorithm**

Course Objectives:
The Student will Learn:

1. To analyze performance of algorithms & Understanding the growth of function.
2. To choose the appropriate data sorting algorithm for performing sorting in data structure.
3. To choose the appropriate data structure and algorithm design method for a specified application.
4. To solve problems using algorithm design methods such as the greedy method, divide and conquer, dynamic programming, backtracking and branch and bound.
5. To analyze performance of string matching and randomized algorithms. To introduce P and NP classes.

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Algorithms, Analyzing Algorithms, Complexity of Algorithms, Growth of Functions, Asymptotic Notations Performance Measurements, Recurrence Relation, Method of Solving recurrence function **Sorting and Order Statistics** – Shell Sort, Quick Sort, Merge Sort, Heap Sort, Comparison of Sorting Algorithms, Sorting in Linear Time.	8L
II	**Advanced Data Structures:** Red-Black Trees, B – Trees, Binomial Heaps, and Fibonacci Heaps.	8L
III	**Divide and Conquer:** Matrix Multiplication, Convex Hull and Searching. Longest Common Subsequence (LCS) Problem **Greedy Methods**: Optimal Reliability Allocation, Knapsack, Minimum Spanning Trees – Prim's and Kruskal's Algorithms, Single Source Shortest Paths – Dijkstra's and Bellman Ford Algorithms.	8L
IV	**Dynamic Programming:** Knapsack, All Pair Shortest Paths – Warshal's and Floyd's Algorithms, Resource Allocation Problem. Branch and Bound : Travelling Salesman Problem, **Backtracking:** Graph Coloring, n-Queen Problem, Hamiltonian Cycles and Sum of Subsets.	8L

V	**String Matching:** Algorithm for string matching, Theory of NP-Completeness, Approximation Algorithms and Randomized Algorithms.	8L

Reference / Text Books:

1. Thomas H. Coreman, Charles E. Leiserson and Ronald L. Rivest, "Introduction to Algorithms", Printice Hall of India.
2. E. Horowitz & S Sahni, "Fundamentals of Computer Algorithms", Aho, Hopcraft, Ullman, "The Design and Analysis of Computer Algorithms" Pearson Education, 2008.
3. LEE "Design & Analysis of Algorithms (POD)",McGraw Hill
4. Robert Sedgewick and Kevin Wayne, Algorithms, fourth edition, Addison Wesley, 2011.
5. Jon Kleinberg and Éva Tardos, Algorithm Design, Pearson, 2005.
6. Michael T Goodrich and Roberto Tamassia, Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Wiley, 2006.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report/Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course: Data Structure

Course Learning Outcomes:

After completing the course, students should be able to:

1. Design new algorithms, prove them correct, and analyze their asymptotic and absolute runtime and memory demands.
2. Find an algorithm to solve the problem (create) and prove that the algorithm solves the problem correctly (validate).
3. Understand the mathematical criterion for deciding whether an algorithm is efficient, and know many practically important problems that do not admit any efficient algorithms.
4. Apply classical sorting, searching, optimization and graph algorithms.
5. Understand basic techniques for designing algorithms, including the techniques of recursion, divide-and-conquer, and greedy.
6. Understand string matching algorithms, approximation algorithms and randomized algorithms.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B.Tech CSE**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Database Management System**
Course Code: SECS-352	**Title: Database Management System**

Course Objectives:
The Student will Learn:

- To understand the basic concepts and the applications of database systems.
- To apply channel allocation, framing, error and flow control techniques.
- To master the basics of SQL and construct queries using SQL.
- To understand the relational database design principles and implementations.
- To understand the transaction processing
- To implement the concurrency techniques in transaction processing

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Overview, Database System vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence and Database Language and Interfaces, Data Definitions Language, DML, Overall Database Structure. Data Modeling Using the Entity Relationship Model: ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Concepts of Super Key, Candidate Key, Primary Key, Generalization, Aggregation, Reduction of an ER Diagrams to Tables, Extended ER Model, Relationship of Higher Degree.	**8L**
II	Relational data Model and Language: Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra, Relational Calculus, Tuple and Domain Calculus. Introduction on SQL: Characteristics of SQL, Advantage of SQL. SQL Data Type and Literals. Types of SQL Commands. SQL Operators and Their Procedure. Tables, Views and Indexes. Queries and Sub Queries. Aggregate Functions. Insert, Update and Delete Operations, Joins, Unions, Intersection, Minus, Cursors, Triggers, Procedures in SQL/PL SQL	**8L**
III	Data Base Design & Normalization: Functional dependencies, normal forms, first, second, 8 third normal forms, BCNF, inclusion	**8L**

	dependence, loss less join decompositions, normalization using FD, MVD, and JDs, alternative approaches to database design	
IV	Transaction Processing Concept: Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Checkpoints, Deadlock Handling. Distributed Database: Distributed Data Storage, Concurrency Control, Directory System.	**8L**
V	Concurrency Control Techniques: Concurrency Control, Locking Techniques for Concurrency Control, Time Stamping Protocols for Concurrency Control, Validation Based Protocol, Multiple Granularity, Multi Version Schemes, Recovery with Concurrent Transaction, Case Study of Oracle.	**8L**

Reference / Text Books:

1. "Data base System Concepts", A. Silberschatz, H.F. Korth, S.Sudarshan, McGraw Hill, VI edition
2. "Fundamental of Database systems " by Elsmasri &Navathe , 6th edition, Addison-Wesley
3. "Data base Concepts" by CJ. Date, 7th edition
4. "Database Management Concepts" by Raghu Ramakrishnan & Johannes Gehrke, 2nd edition.
5. Database Principles, Programming, and Performance, P.O'Neil, E.O'Neil, 2nd ed., ELSEVIER.
6. Database Management Systems, G.K. Gupta, TMH.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	10
3) Assignments	-
4) Research Project Report/Seminar On Research Project Report	10
5) ESE	100
Total:	**150**

Prerequisites for the course: Nil

Course Learning Outcomes:

After completing the course, students should be able to:

1. To memorize the basic concept of database systems and to understand the database modeling concept using ER modeling.
2. To understand and apply the concept of relational data model and SQL for database management.
3. To understand and apply the concept of normalization using FD, MVD & JD's for designing database effectively.
4. To understand the Transaction processing fundamentals and transaction management.
5. To understand the concept of deadlock and distributed database.
6. To understand various protocols for maintaining concurrency in transactions of real world scenarios.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B.Tech CSE**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Discrete Structures & Theory of Logic**
Course Code: SECS-353	**Title: Discrete Structures & Theory of Logic**

Course Objectives:
The Student will Learn:

- To acquaint the concept of set theory, relations and functions.
- To understand the concepts related to algebraic structures.
- To introduce the fundamentals of Boolean algebra and its properties.
- To acquaint the concept of Propositional Logic and Predicate Logic
- To use concept of trees and graph theory for solving practical problems.

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Set Theory: Introduction, Combination of sets, Multisets, Ordered pairs. Proofs of some general identities on sets. Relations: Definition, Operations on relations, Properties of relations, Composite Relations, Equality of relations, Recursive definition of relation, Order of relations. Functions: Definition, Classification of functions, Operations on functions, Recursively defined functions. Growth of Functions.	**8L**
II	Algebraic Structures: Definition, Groups, Subgroups and order, Cyclic Groups, Cosets, Lagrange's theorem, Normal Subgroups, Permutation and Symmetric groups, Group Homomorphisms, Definition and elementary properties of Rings and Fields.	**8L**
III	Lattices: Definition, Properties of lattices – Bounded, Complemented, Modular and Complete lattice. Boolean Algebra: Introduction, Axioms and Theorems of Boolean algebra, Algebraic manipulation of Boolean expressions. Simplification of Boolean Functions, Karnaugh maps, Logic gates, Digital circuits and Boolean algebra.	**8L**
IV	Propositional Logic: Proposition, well-formed formula, Truth tables, Tautology, Satisfiability, Contradiction, Algebra of proposition, Theory of Inference. Predicate Logic: First order predicate, well-formed formula of predicate, quantifiers, Inference theory of predicate logic	**8L**

V	Trees: Definition, Binary tree, Binary tree traversal, Binary search tree. Graphs: Definition and terminology, Representation of graphs, Multigraphs, Bipartite graphs, Planar graphs, Isomorphism and Homeomorphism of graphs, Euler and Hamiltonian paths, Graph coloring, Recurrence Relation & Generating function: Recursive definition of functions, Recursive algorithms, Method of solving recurrences. Combinatorics: Introduction, Counting Techniques, Pigeonhole Principle.	**8L**

Reference / Text Books:

1. Hari Krishan, Discrete Mathematics, Pragati Edition
2. Lipchitz, S. & Lipson S., Discrete Mathematics, Outline series Tata McGraw Hill.
3. Kumar, S.S., Discrete Mathematics, S. Chand.
4. Dean, N., Essence of Discrete Mathematics, Prentice Hall Liu, C.L., Elements of Discrete Mathematics, McGraw Hill.
5. Rosen, Kenneth H., Discrete Mathematics and Its Applications, McGraw Hill.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	20
3) Assignments	-
4) Research Project Report/Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

After completing the course, students should be able to:

1. To memorize and understand the concept of set theory, relation and function.
2. To understand the fundamentals of algebraic structures
3. To understand the fundamentals of Boolean algebra and illustrate their properties
4. To understand the concept of Propositional Logic and Predicate Logic and illustrate their properties.
5. To memorize and understand the concept of trees & graphs and exhibit their properties effectively.
6. To memorize and understand the concept of Recurrence Relation, Generating function and Combinatorics.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B.Tech CSE**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Machine Learning Techniques**
Course Code: SDCS- 351-1	**Title: Machine Learning Techniques**

Course Objectives:
The Student will Learn:
1. To understand the concept of machine learning.
2. To acquaint the concept of Regression and Support vector machine.
3. To introduce the concept of decision tree learning.
4. To understand the concept of artificial neural network and deep learning.
5. To acquaint the concept of Reinforcement Learning.

Nature of Paper: Department Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION:** Learning, Types of Learning, Well defined learning problems, Designing a Learning System, History of ML, Introduction of Machine Learning Approaches – (Artificial Neural Network, Clustering, Reinforcement Learning, Decision Tree Learning, Bayesian networks, Support Vector Machine, Genetic Algorithm), Issues in Machine Learning and Data Science Vs Machine Learning;	**8L**
II	**REGRESSION:** Linear Regression and Logistic Regression BAYESIAN LEARNING - Bayes theorem, Concept learning, Bayes Optimal Classifier, Naïve Bayes classifier, Bayesian belief networks, EM algorithm. SUPPORT VECTOR MACHINE: Introduction, Types of support vector kernel – (Linear kernel, polynomial kernel, and Gaussiankernel), Hyperplane – (Decision surface), Properties of SVM, and Issues in SVM	**8L**
III	**DECISION TREE LEARNING:** Decision tree learning algorithm, Inductive bias, Inductive inference with decision trees, Entropy and information theory, Information gain, ID-3 Algorithm, Issues in Decision tree learning. INSTANCE-BASED LEARNING – k-Nearest Neighbour Learning, Locally Weighted Regression, Radial basis function networks, Case-based learning	**8L**
IV	**ARTIFICIAL NEURAL NETWORKS:** Perceptron's, Multilayer perceptron, Gradient descent and the Delta rule, Multilayer networks,	**8L**

	Derivation of Back propagation Algorithm, Generalization, Unsupervised Learning – SOM Algorithm and its variant; DEEP LEARNING - Introduction, concept of convolutional neural network, Types of layers – (Convolutional Layers , Activation function, pooling, fully connected) , Concept of Convolution (1D and 2D) layers, Training of network, Case study of CNN for eg on Diabetic Retinopathy, Building a smart speaker, Self-deriving car etc.	
V	REINFORCEMENT LEARNING–Introduction to Reinforcement Learning, Learning Task, Example of Reinforcement Learning in Practice, Learning Models for Reinforcement – (Markov Decision process, Q Learning - Q Learning function, Q Learning Algorithm), Application of Reinforcement Learning, Introduction to Deep Q Learning. GENETIC ALGORITHMS: Introduction, Components, GA cycle of reproduction, Crossover, Mutation, Genetic Programming, Models of Evolution and Learning, Applications	**8L**

Reference / Text Books:

1. Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
2. Ethem Alpaydin, ―Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.
3. Stephen Marsland, ―Machine Learning: An Algorithmic Perspective, CRC Press, 2009.
4. Bishop, C., Pattern Recognition and Machine Learning. Berlin: Springer-Verlag.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report Seminar On Research Project Report	20
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

After completing the course, students should be able to:

1. To understand the need for machine learning for various problem solving.
2. To understand a wide variety of learning algorithms and how to evaluate models generated from data.
3. To understand the latest trends in machine learning.
4. To design appropriate machine learning algorithms and apply the algorithms to a real-world problems.
5. To optimize the models learned and report on the expected accuracy that can be achieved by applying the models.
6. To understand the concept of reinforcement Learning and genetic algorithms.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B.Tech CSE**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Application of Soft Computing**
Course Code: SDCS- 351-2	**Title: Application of Soft Computing**

Course Objectives:
The Student will Learn:

1. To introduce the concept of soft computing.
2. To acquaint the concept of Fuzzy System.
3. To understand the concepts of Neuro-fuzzy Modeling.
4. To introduce the concept of genetic algorithms.
5. To understand the applications of soft computing and to introduction MATLAB Environment.

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to Soft Computing, ARTIFICIAL NEURAL NETWORKS Basic concepts - Single layer perception - Multilayer Perception - Supervised and Unsupervised learning – Back propagation networks - Kohnen's self-organizing networks - Hopfield network.	**8L**
II	FUZZY SYSTEMS Fuzzy sets, Fuzzy Relations and Fuzzy reasoning, Fuzzy functions - Decomposition - Fuzzy automata and languages - Fuzzy control methods - Fuzzy decision making.	**8L**
III	NEURO - FUZZY MODELING Adaptive networks based Fuzzy interface systems - Classification and Regression Trees - Data clustering algorithms - Rule based structure identification - Neuro-Fuzzy controls - Simulated annealing – Evolutionary computation	**8L**
IV	GENETIC ALGORITHMS Survival of the Fittest - Fitness Computations - Cross over - Mutation - Reproduction - Rank method - Rank space method	**8L**
V	APPLICATION OF SOFT COMPUTING Optimization of traveling salesman problem using Genetic Algorithm, Genetic algorithm based Internet Search Techniques, Soft computing based hybrid fuzzy controller, Introduction to MATLAB Environment for Soft computing Techniques.	**8L**

Reference / Text Books:

1. An Introduction to Genetic Algorithm Melanic Mitchell (MIT Press)
2. Evolutionary Algorithm for Solving Multi-objective, Optimization Problems (2nd Edition), Collelo, Lament, Veldhnizer (Springer)
3. Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley)
4. Neural Networks and Learning Machines Simon Haykin (PHI)
5. Sivanandam, Deepa, "Principles of Soft Computing", Wiley

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course: Fuzzy Logic

Course Learning Outcomes:

After completing the course, students should be able to:

1. To memorize and understand the concept of soft computing.
2. To understand the fundamentals of Fuzzy System.
3. To understand the fundamentals of Neuro-fuzzy Modeling
4. To understand the concept of genetic algorithms.
5. To understand the concept of genetic algorithm based Internet Search Techniques.
6. To memorize and understand the concept of applications of soft computing.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B.Tech CSE**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Augmented & Virtual Reality**
Course Code: SDCS- 351-3	**Title: Augmented & Virtual Reality**

Course Objectives:
The Student will Learn:
1. To introduce the concept of Virtual reality and virtual environments.
2. To acquaint the concept of 3D user interface input hardware.
3. To understand the concepts of Software technologies and VR environment.
4. To introduce the concept of 3D Interaction Techniques.
5. To understand the applications of Augmented and Mixed Reality.

Nature of Paper: Department elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**VIRTUAL REALITY AND VIRTUAL ENVIRONMENTS:** The historical development of VR: Scientific landmarks Computer Graphics, Real-time computer graphics, Flight simulation, Virtual environments, Requirements for VR, benefits of Virtual reality. HARDWARE TECHNOLOGIES FOR 3D USER INTERFACES: Visual Displays Auditory Displays, Haptic Displays, Choosing Output Devices for 3D User Interfaces	**8L**
II	**3D USER INTERFACE INPUT HARDWARE:** Input device characteristics, Desktop input devices, Tracking Devices, 3D Mice, Special Purpose Input Devices, Direct Human Input, Home - Brewed Input Devices, Choosing Input Devices for 3D Interfaces.	**8L**
III	**SOFTWARE TECHNOLOGIES:** Database - World Space, World Coordinate, World Environment, Objects - Geometry, Position / Orientation, Hierarchy, Bounding Volume, Scripts and other attributes, VR Environment - VR Database, Tessellated Data, LODs, Cullers and Occluders, Lights and Cameras, Scripts, Interaction - Simple, Feedback, Graphical User Interface, Control Panel, 2D Controls, Hardware Controls, Room / Stage / Area Descriptions, World Authoring and Playback, VR toolkits, Available software in the market	**8L**
IV	**3D INTERACTION TECHNIQUES:** 3D Manipulation tasks, Manipulation Techniques and Input Devices, Interaction Techniques	**8L**

	for 3D Manipulation, Deign Guidelines - 3D Travel Tasks, Travel Techniques, Design Guidelines - Theoretical Foundations of Way finding, User Centered Wayfinding Support, Environment Centered Way finding Support, Evaluating Wayfinding Aids, Design Guidelines - System Control, Classification, Graphical Menus, Voice Commands, Gestrual Commands, Tools, Mutimodal System Control Techniques, Design Guidelines, Case Study: Mixing System Control Methods, Symbolic Input Tasks, symbolic Input Techniques, Design Guidelines, Beyond Text and Number entry . DESIGNING AND DEVELOPING 3D USER INTERFACES: Strategies for Designing and Developing Guidelines and Evaluation. VIRTUAL REALITY APPLICATIONS: Engineering, Architecture, Education, Medicine, Entertainment, Science, Training.	
V	Augmented and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems	**8L**

Reference / Text Books:

1. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.
2. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
3. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.
4. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005.
5. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, India, 2003.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	10
5) ESE	100
Total:	**150**

Prerequisites for the course: Computer Graphics

Course Learning Outcomes:

After completing the course, students should be able to:

1. To memorize and understand the concept of Virtual reality and virtual environments.
2. To understand the fundamentals of 3D user interface input hardware.
3. To understand the fundamentals of Software technologies and VR environment.
4. To understand the concept of 3D Interaction Techniques.
5. To understand the concept of designing and developing 3D user interface and Virtual reality applications.
6. To memorize and understand the concept of Augmented and Mixed Reality.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B.Tech CSE**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Human Computer Interface**
Course Code: SDCS- 351-4	**Title: Human Computer Interface**

Course Objectives:
The Student will Learn:
1. To introduce the concept of user interface and graphical user interface.
2. To acquaint the concept of design process.
3. To understand the concepts of screen designing.
4. To introduce the concept of windows and multimedia.
5. To understand the applications of software tools and interaction tools.

Nature of Paper: Department Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Importance of user Interface its definition, importance and benefits of good design, Overview history of Screen design. The graphical user interface – popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user – Interface popularity, characteristics- Principles of user interface	**8L**
II	**Design process**: Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions. Screen Designing: Design goals of screen designing.	**8L**
III	**Screen Designing:** Design goals – Screen planning and purpose, organizing screen elements, ordering of screen data and content – screen navigation and flow – Visually pleasing composition – amount of information – focus and emphasis – presentation information simply and meaningfully – information retrieval on web – statistical graphics – Technological consideration in interface design.	**8L**
IV	**Windows:** New and Navigation schemes selection of window, selection of devices based and screen based controls. Components – text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors	**8L**
V	**Software tools:** Specification methods, interface – Building Tools. Interaction Devices – Keyboard and function keys – pointing	**8L**

	devices – speech recognition digitization and generation – image and video displays – drivers.	

Reference / Text Books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale Human Computer Interaction, 3rd Edition Prentice Hall, 2004.
2. Jonathan Lazar Jinjuan Heidi Feng, Harry Hochheiser, Research Methods in Human Computer Interaction, Wiley, 2010.
3. Ben Shneiderman and Catherine Plaisant Designing the User Interface: Strategies for Effective Human-Computer Interaction (5th Edition, pp. 672, ISBN 0- 321-53735-1, March 2009), Reading, MA: Addison-Wesley Publishing Co.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course: Nil

Course Learning Outcomes:

After completing the course, students should be able to:

1. Understanding user interface good design.
2. Analyzing the design process and understanding human interaction with computers.
3. Analyzing the screen design process and understanding human interaction with computers.
4. Understand the technological consideration in interface design.
5. Understanding windows, components and multimedia.
6. Understanding software tools and interaction devices.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B.Tech-CSE**	**Year: III** **Semester: V**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Design Analysis and Algorithm lab**
Course Code: SECS-251P	**Title: Design Analysis and Algorithm lab**

Course Objectives:

1. The principle objective of this course is to build solid foundation in algorithms and their applications.
2. To implement various divide and conquer techniques examples.
3. To implement various Greedy techniques examples.
4. To implement various Dynamic Programming techniques examples.
5. To provide a practical exposure of all algorithms.
6. To understand the importance of algorithm and its complexities

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 2 Credits

L: 0
T: 0
P:3 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Write a program to perform operation count for a given pseudo code	2
II	Write a program to perform Bubble sort for any given list of numbers.	2
III	Write a program to perform Insertion sort for any given list of numbers.	2
IV	Write a program to perform Quick Sort for the given list of integer values.	2
V	Write a program to find Maximum and Minimum of the given set of integer values.	2
VI	Write a Program to perform Merge Sort on the given two lists of integer values.	2
VII	Write a Program to perform Binary Search for a given set of integer values recursively and nonrecursively.	2
VIII	Write a program to find solution for knapsack problem using greedy method.	2
IX	Write a program to find minimum cost spanning tree using Prim's Algorithm.	2
X	Write a program to find minimum cost spanning tree using Kruskal's Algorithm	2

Reference / Text Books:

1. Thomas H. Coreman, Charles E. Leiserson and Ronald L. Rivest, "Introduction to Algorithms",
2. Printice Hall of India. 2. E. Horowitz & S Sahni, "Fundamentals of Computer Algorithms".

Evaluation/Assessment Methodology	
	Max. Marks:50
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report Seminar On Research Project Report	-
5) ESE	30
Total:	**50**

Course Learning Outcomes:

Student will be able to :

1. To learn the importance of designing an algorithm in an effective way by considering space and time complexity
2. To learn divide and conquer strategy based algorithms
3. To learn greedy method based algorithms
4. To learn the dynamic programming design techniques
5. To develop Recursive backtracking algorithms
6. To learn graph search and network flow algorithms

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG (R) **Class: B.Tech(CSE)**	**Year: III** **Semester: V**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: DBMS LAB**
Course Code: SECS-352P	**Title: DBMS LAB**

Course Objectives:
1. To understand the basic concepts and the applications of database systems.
2. To master the basics of SQL and construct queries using SQL.
3. To understand the relational database design principles.
4. To become familiar with the basic issues of transaction.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 2 Credits

L:
T:
P:3 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Installing oracle.	2
II	Creating Entity-Relationship Diagram using case tools.	2
III	Writing SQL statements Using ORACLE	2
IV	Writing basic SQL SELECT statements	2
V	Restricting and sorting data.	2
VI	Displaying data from multiple tables.	2
VII	Aggregating data using group function	2

Reference / Text Books:
1. Korth, Silbertz, Sudarshan," Database Concepts", McGraw Hill 2. Date C J, "An Introduction to Database Systems", Addision Wesley

If the course is available as Generic Elective then the students of following departments may opt it. 1.

Evaluation/Assessment Methodology

	Max. Marks:50
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	30
Total:	**50**

Course learning outcomes: Student will be able to :
1. Get practical knowledge on designing and creating relational database systems.
2. Understand various advanced queries execution such as relational constraints, joins, set operations, aggregate functions, trigger, views and embedded SQL.
3. Use various software to design and build ER Diagrams, UML, Flow chart for related database

systems.
4. Able to design and implement database applications on their own.
5. Display data from multiple tables.
6. Able to implement Restrict and sort data.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG (R) **Class: B.TECH-CSE**	**Year: III** **Semester: V**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Discrete Structures & Theory of Logic Lab**
Course Code: SECS-353P	**Title: Discrete Structures & Theory of Logic Lab**

Course Objectives:
1. To implement basic discrete structures algorithms
2. To analyze algebraic techniques and implement algebraic operations.
3. To implement logical problems like Boolean algebra, poker hand problem and birthday problem
4. To implement closed formula of recursive sequence

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 2 Credits

L:
T:
P:3 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Implementation basic python program related to Data types, operators. a) Evaluate value of 2x3 - 6x2 + 2x - 1 for x = 3 b) Write a Python program to find the roots of a quadratic function ax2 + bx + c = 0, where a, b and c are real numbers and a ≠ 0	2
II	Implementation of decision, Loop in python. a) Write a program to calculate factorial of a number. b) Write a program to calculate sum of first n natural numbers where n is finite. c) Write a program for cube sum of first n natural numbers where n is finite.	2
III	Implementation of various set operations (union, intersection, difference, symmetric difference, Power set, cardinality).	2
IV	**Write program to perform following operation:** a) Is the given relation is reflexive? b) Is the given relation is symmetric? c) Is the given relation is Transitive.	2
V	Write program to generate recursive sequence of a closed formula and also calculate its value at particular non negative integer recursively for the following: a) Polynomial 2n b) Fibonacci sequence c) Factorial of a number	2

VI	**Write program to:** a. Perform + m (addition modulo) and xm (multiplication modulo) for a particular set. b. Check closure property for + m (addition modulo) and xm (multiplication modulo) for any set you have assumed. c. Find identity element in any given algebraic system if exist. Find inverse of all elements in a given group if identity element is given.	2
VII	**Write program for various number systems:** a. Decimal to binary, octal & hexadecimal b. Binary to decimal, octal and hexadecimal c. Octal to decimal, binary and hexadecimal d. Hexadecimal to decimal, binary and octal e. Logic gate simulation AND, OR, NOT, EXOR, NOR	2

Reference / Text Books:

1. Liu and Mohapatra, "Elements of Distcrete Mathematics", McGraw Hill.

If the course is available as Generic Elective then the students of following departments may opt it.1.

Evaluation/Assessment Methodology

Max. Marks:50

1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	30
Total:	**50**

Course Learning outcomes

Student will be able:

1. To implement basic discrete structures algorithms.
2. To analyze algebraic techniques and implement algebraic operations.
3. To implement logical problems like Boolean algebra, poker hand problem and birthday problem.
4. To implement closed formula of recursive sequence.
5. Implement the following operation:
   a) Is the given relation is reflexive?
   b) Is the given relation is symmetric
   c) Is the given relation is Transitive.
6. Implement various set operations union, intersection, difference, symmetric difference, Power set, cardinality.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B.Tech CSE**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Computer Networks**
Course Code: SECS-361	**Title: Computer Networks**

Course Objectives:
The Student will Learn:

- To explain basic concepts, OSI reference model, services and role of each layer of OSI model and TCP/IP, networks devices and transmission media, Analog and digital data transmission, Vulnerabilities in any computing system and security solution.
- To apply channel allocation, framing, error and flow control techniques.
- To describe the functions of Network Layer i.e. Logical addressing, sub netting & Routing Mechanism.
- To explain the different Transport Layer function i.e. Port addressing, Connection Management, Error control and Flow control mechanism.
- To explain the functions offered by session and presentation layer and their Implementation.
- To explain the different protocols used at application layer i.e. HTTP, SNMP, SMTP, FTP, TELNET and VPN.

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introductory Concepts**: Goals, applications and categories of networks, Internet Organization, ISP, Network structure and architecture (layering principles, services, protocols and standards), Overview of OSI reference model, Overview of TCP/IP protocol suite, Network devices and components. **Physical Layer:** Network topology design, Types of connections, Transmission media, Signal transmission and encoding, Network performance and transmission impairments, Switching techniques and multiplexing.	**8L**
II	**Link layer:** Framing, Error Detection and Correction, Flow control (Elementary Data Link Protocols, Sliding Window protocols). Medium Access Control and Local Area Networks: Channel allocation, Multiple access protocols, LAN standards, Link layer switches & bridges (learning bridge and spanning tree algorithms).	**8L**
III	**Network Layer:** Point-to-point networks, Logical addressing, Basic internetworking (IP, CIDR, ARP, RARP, DHCP, ICMP),	**8L**

	Routing, forwarding and delivery, Static and dynamic routing, Routing algorithms and protocols, Congestion control algorithms, IPv6.	
IV	**Transport Layer:** Process-to-process delivery, Transport layer protocols (UDP and TCP), Multiplexing, Connection management, Flow control and retransmission, Window management, TCP Congestion control, Quality of service.	**8L**
V	**Application Layer:** DNS, WWW and HTTP, Electronic mail, FTP, Remote login, Network management, Data compression, Cryptography – basic concepts.	**8L**

Reference / Text Books:

1. Behrouz Forouzan, "Data Communication and Networking", McGraw Hill.
2. Andrew Tanenbaum "Computer Networks", Prentice Hall.
3. William Stallings, "Data and Computer Communication", Pearson.
4. Kurose and Ross, "Computer Networking- A Top-Down Approach", Pearson.
5. Peterson and Davie, "Computer Networks: A Systems Approach", Morgan Kaufmann.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	10
5) ESE	100
Total:	**150**

Prerequisites for the course: NIL

Course Learning Outcomes:

After completing the course, students should be able to:

1. Explain basic concepts, OSI reference model, services and role of each layer of OSI model and TCP/IP, networks devices and transmission media, Analog and digital data transmission
2. Apply channel allocation, framing, error and flow control techniques.
3. Describe the functions of Network Layer i.e. Logical addressing, subnetting & Routing Mechanism.
4. Explain the different Transport Layer function i.e. Port addressing, Connection Management, Error control and Flow control mechanism.
5. Explain the functions offered by session and presentation layer and their Implementation.
6. Explain the different protocols used at application layer i.e. HTTP, SNMP, SMTP, FTP, TELNET and VPN

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B.Tech CSE**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Compiler Design**
Course Code: SECS-362	**Title: Compiler Design**

Course Objectives:
The Student will Learn:

- To understand the concept of phases and passes of compiler and its tools like LEX and YAAC.
- To acquaint with knowledge of various parsers and parsing techniques.
- To analyze and implement compiler by Syntax-directed Translation schemes.
- To understand the concept of symbol table and error detection and recovery mechanism.
- To understand the concept of code generation and code optimization.

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Compiler:** Phases and passes, Bootstrapping, Finite state machines and regular expressions and their applications to lexical analysis, Optimization of DFA-Based Pattern Matchers implementation of lexical analyzers, lexical-analyzer generator, LEX compiler, Formal grammars and their application to syntax analysis, BNF notation, ambiguity, YACC. The syntactic specification of programming languages: Context free grammars, derivation and parse trees, capabilities of CFG.	**8L**
II	Basic Parsing Techniques: Parsers, Shift reduce parsing, operator precedence parsing, top down parsing, predictive parsers Automatic Construction of efficient Parsers: LR parsers, the canonical Collection of LR(0) items, constructing SLR parsing tables, constructing Canonical LR parsing tables, Constructing LALR parsing tables, using ambiguous grammars, an automatic parser generator, implementation of LR parsing tables.	**8L**
III	**Syntax-directed Translation:** Syntax-directed Translation schemes, Implementation of Syntax directed Translators, Intermediate code, postfix notation, Parse trees & syntax trees, three address code, quadruple & triples, translation of assignment statements, Boolean expressions, statements that alter the flow of control, postfix translation, translation with a top down parser. More about translation: Array references in arithmetic expressions, procedures	**8L**

	call, declarations and case statements	
IV	**Symbol Tables:** Data structure for symbols tables, representing scope information. **Run-Time Administration:** Implementation of simple stack allocation scheme, storage allocation in block structured language. **Error Detection & Recovery:** Lexical Phase errors, syntactic phase errors semantic errors.	**8L**
V	**Code Generation**: Design Issues, the Target Language. Addresses in the Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Code Generator. **Code optimization:** Machine-Independent Optimizations, Loop optimization, DAG representation of basic blocks, value numbers and algebraic laws, Global Data-Flow analysis.	**8L**

Reference / Text Books:

1. K. Muneeswaran,Compiler Design, First Edition, Oxford University Press.
2. J.P. Bennet, "Introduction to Compiler Techniques", Second Edition, Tata McGraw-Hill, 2003.
3. Henk Alblas and Albert Nymeyer, "Practice and Principles of Compiler Building with C", PHI, 2001.
4. Aho, Sethi & Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education.
5. V Raghvan, " Principles of Compiler Design", TMH.
6. Kenneth Louden," Compiler Construction", Cengage Learning.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report Seminar On Research Project Report	20
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

After completing the course, students should be able to:

1. To explain the different phases and passes of compiler and eventually recognize patterns, tokens and regular expressions.
2. To implement the concept of parsers and construct the parsing tables
3. To illustrate and create the intermediate code
4. To analyze and implement compiler by Syntax-directed Translation schemes.
5. To summarize the knowledge of various parsers and parsing techniques.
6. To integrate the concept of code generation and code optimization.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B.Tech CSE**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: BIG DATA**
Course Code: SDCS-361	**Title: BIG DATA**

Course Objectives:
The Student will Learn:

- To demonstrate knowledge of Big Data Analytics concepts and its applications in business.
- To demonstrate functions and components of Map Reduce Framework and HDFS.
- To discuss Data Management concepts in NoSQL environment.
- To explain process of developing Map Reduce based distributed processing applications.
- To explain process of developing applications using HBASE, Hive, Pig etc.
- To demonstrate knowledge of Big Data Analytics concepts and its applications in business.

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Big Data**: Types of digital data, history of Big Data innovation, introduction to Big Data platform, drivers for Big Data, Big Data architecture and characteristics, 5 Vs of Big Data, Big Data technology components, Big Data importance and applications, Big Data features – security, compliance, auditing and protection, Big Data privacy and ethics, Big Data Analytics, Challenges of conventional systems, intelligent data analysis, nature of data, analytic processes and tools, analysis vs reporting, modern data analytic tools.	**8L**
II	**Hadoop:** History of Hadoop, Apache Hadoop, the Hadoop Distributed File System, components of Hadoop, data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, Hadoop Echo System. **Map Reduce:** Map Reduce framework and basics, how Map Reduce works, developing a Map Reduce application, unit tests with MR unit, test data and local tests, anatomy of a Map Reduce job run, failures, job scheduling, shuffle and sort, task execution, Map Reduce types, input formats, output formats, Map Reduce features, Real-world Map Reduce	**8L**
III	**HDFS (Hadoop Distributed File System):** Design of HDFS, HDFS concepts, benefits and challenges, file sizes, block sizes and block abstraction in HDFS, data replication, how does HDFS store, read, and	**8L**

	write files, Java interfaces to HDFS, command line interface, Hadoop file system interfaces, data flow, data ingest with Flume and Scoop, Hadoop archives, Hadoop I/O: compression, serialization, Avro and file-based data structures. **Hadoop Environment:** Setting up a Hadoop cluster, cluster specification, cluster setup and installation, Hadoop configuration, security in Hadoop, administering Hadoop, HDFS monitoring & maintenance, Hadoop benchmarks, Hadoop in the cloud	
IV	**Hadoop Eco System and YARN**: Hadoop ecosystem components, schedulers, fair and capacity, Hadoop 2.0 New Features - NameNode high availability, HDFS federation, MRv2, YARN, Running MRv1 in YARN. **NoSQL Databases:** Introduction to NoSQL **MongoDB:** Introduction, data types, creating, updating and deleting documents, querying,introduction to indexing, capped collections **Spark:** Installing spark, spark applications, jobs, stages and tasks, Resilient DistributedDatabases, anatomy of a Spark job run, Spark on YARN **SCALA:** Introduction, classes and objects, basic types and operators, built-in controlstructures, functions and closures, inheritance.	**8L**
V	**Hadoop Eco System Frameworks**: Applications on Big Data using Pig, Hive and HBase **Pig** - Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators, **Hive** - Apache Hive architecture and installation, Hive shell, Hive services, Hive metastore, comparison with traditional databases, HiveQL, tables, querying data and user defined functions, sorting and aggregating, Map Reduce scripts, joins & sub queries. **HBase** – Hbase concepts, clients, example, Hbase vs RDBMS, advanced usage, schema design, advance indexing, Zookeeper – how it helps in monitoring a cluster, how to build applications with Zookeeper. IBM Big Data strategy, introduction to Infosphere, BigInsights and Big Sheets, introduction to Big SQL.	**8L**

Reference / Text Books:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley
2. Big-Data Black Book, DT Editorial Services, Wiley
3. Dirk deRoos, Chris Eaton, George Lapis, Paul Zikopoulos, Tom Deutsch, "Understanding Big Data Analytics forEnterprise Class Hadoop and Streaming Data", McGraw Hill.
4. Thomas Erl, Wajid Khattak, Paul Buhler, "Big Data Fundamentals: Concepts, Drivers and Techniques", PrenticeHall.
5. Bart Baesens "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications (WILEYBig Data Series)", John Wiley & Sons
6. Arshdeep Bahga, Vijay Madisetti, "Big Data Science & Analytics: A Hands On Approach ", VPT

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination 2) Presentations /Seminar	30

3) Assignments 4) Research Project Report Seminar On Research Project Report 5) ESE	20 - 100
Total:	**150**
Prerequisites for the course: DBMS	
Course Learning Outcomes: **After completing the course, students should be able to:** 1. Demonstrate knowledge of Big Data Analytics concepts and its applications in business. 2. Demonstrate functions and components of Map Reduce Framework and HDFS 3. Discuss Data Management concepts in NoSQL environment. 4. Explain process of developing Map Reduce based distributed processing applications. 5. Explain process of developing applications using HBASE, Hive, Pig etc. 6. Explain demonstrate knowledge of Big Data Analytics concepts and its applications in business.	

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B.Tech CSE**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Image Processing**
Course Code: SDCS-362	**Title: Image Processing**

Course Objectives:
The Student will Learn:

- Student will be able to explain the basic concepts of two-dimensional signal acquisition, sampling, quantization and color model.
- Student will be able to apply image processing techniques for image enhancement in both the spatial and frequency domains.
- Student will be able to apply and compare image restoration techniques in both spatial and frequency domain
- Student will be able to compare edge based and region based segmentation algorithms for ROI extraction.
- Student will be able to explain compression techniques and descriptors for image processing.

Nature of Paper: Elective Paper

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**DIGITAL IMAGE FUNDAMENTALS:** Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels – Color image fundamentals – RGB, HSI models,Two-dimensional mathematical preliminaries, 2D transforms – DFT, DCT.	**8L**
II	**IMAGE ENHANCEMENT:** Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.	**8L**
III	**IMAGE RESTORATION:** Image Restoration – degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering	**8L**

IV	**IMAGE SEGMENTATION:** Edge detection, Edge linking via Hough transform – Thresholding – Region based segmentation –Region growing – Region splitting and merging–Morphological processing-erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.	**8L**
V	**IMAGE COMPRESSION AND RECOGNITION:** Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture – Patterns and Pattern classes – Recognition based on matching.	**8L**

Reference / Text Books:

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing Pearson, Third Edition, 2010.
2. Anil K. Jain, Fundamentals of Digital Image Processing Pearson, 2002.
3. Kenneth R. Castleman, Digital Image Processing Pearson, 2006.
4. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Digital Image Processing using MATLAB Pearson Education,Inc., 2011.
5. D,E. Dudgeon and RM. Mersereau, Multidimensional Digital Signal Processing Prentice Hall Professional TechnicalReference, 1990.
6. William K. Pratt,Digital Image Processing John Wiley, New York, 2002.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	10
5) ESE	100
Total:	**150**

Prerequisites for the course: NIL

Course Learning Outcomes:

After completing the course, students should be able to:

1. Explain the basic concepts of two-dimensional signal acquisition, sampling, quantization
2. Compare and contrast different color model.
3. Apply image processing techniques for image enhancement in both the spatial and frequency domains.
4. Apply and compare image restoration techniques in both spatial and frequency domain.
5. Compare edge based and region based segmentation algorithms for ROI extraction.
6. Explain compression techniques and descriptors for image processing.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B.Tech CSE**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Real Time Systems**
Course Code: SDCS-363	**Title: Real Time Systems**

Course Objectives:
The Student will Learn:

1. To illustrate the need and the challenges in the design of hard and soft real time systems.
2. To compare different scheduling algorithms and the schedule criteria.
3. To discuss resource sharing methods in real time environment.
4. To compare and contrast different real time communication and medium access control techniques.
5. To analyze real time Operating system and Commercial databases.

Nature of Paper: Elective Paper

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction** Definition, Typical Real Time Applications: Digital Control, High Level Controls, Signal Processing etc., Release Times, Deadlines, and Timing Constraints, Hard Real Time Systems and Soft Real Time Systems, Reference Models for Real Time Systems: Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency.	**8L**
II	**Real Time Scheduling** Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems, Optimality of Effective-Deadline First (EDF) and Least-Slack-Time-First (LST) Algorithms, Rate Monotonic Algorithm, Offline Versus Online Scheduling, Scheduling Aperiodic and Sporadic jobs in Priority Driven and Clock Driven Systems.	**8L**
III	**Resources Sharing** Effect of Resource Contention and Resource Access Control (RAC), Non-preemptive Critical Sections, Basic Priority-Inheritance and Priority-Ceiling Protocols, Stack Based Priority-Ceiling Protocol, Use of Priority-Ceiling Protocol in Dynamic Priority Systems, Preemption Ceiling Protocol, Access Control in Multiple-Unit Resources,	**8L**

	Controlling Concurrent Accesses to Data Objects.	
IV	**Real Time Communication** Basic Concepts in Real time Communication, Soft and Hard RT Communication systems, Model of Real Time Communication, Priority-Based Service and Weighted Round-Robin Service Disciplinesfor Switched Networks, Medium Access Control Protocols for Broadcast Networks, Internet and Resource Reservation Protocols	**8L**
V	**Real Time Operating Systems and Databases** Features of RTOS, Time Services, UNIX as RTOS, POSIX Issues, Characteristic of Temporal data, Temporal Consistency, Concurrency Control, Overview of Commercial Real Time databases	**8L**

Reference / Text Books:

1. Real Time Systems by Jane W. S. Liu, Pearson Education Publication.
2. Phillip A Laplanta, SeppoJ. Ovaska Real time System Design and Analysis Tools for practitioner, Wiley
3. Mall Rajib, "Real Time Systems", Pearson Education
4. Albert M. K. Cheng , "Real-Time Systems: Scheduling, Analysis, and Verification", Wiley

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	10
3) Assignments	-
4) Research Project Report / Seminar On Research Project Report	10
5) ESE	100
Total:	**150**

Prerequisites for the course: NIL

Course Learning Outcomes:

After completing the course, students should be able to:

1. Illustrate the need and the challenges in the design of hard and soft real time systems.
2. Compare different scheduling algorithms and the schedule criteria.
3. Discuss resource sharing methods in real time environment.
4. Compare and contrast different real time communication techniques.
5. Compare different medium access control techniques.
6. Analyze real time Operating system and Commercial databases.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B.Tech CSE**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Data Compression**
Course Code: SDCS-364	**Title: Data Compression**

Course Objectives:
The Student will Learn:

- Student will be able to explain the basic concepts of Compression Techniques.
- Student will be able to apply coding algorithm Techniques.
- Student will be able to apply Applications like Bi-level image compression, JBIG standard, JBIG2, Image compression and Dictionary Techniques.
- Student will be able to understand different Models and Scalar Quantization.
- Student will be able to compare Vector Quantization and Scalar Quantization.

Nature of Paper: Elective Paper

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Overview of Compression Techniques: Loss less compression, Lossy Compression, Measures of performance, Modeling and coding, Mathematical Preliminaries for Lossless compression: Introduction to information theory, Description of Models: Physical models, Probability models, Markov models, composite source model, Overview of Coding: uniquely decodable codes and Prefix codes.	**8L**
II	Description of Huffman coding algorithm: Minimum variance Huffman codes, Adaptive Huffman coding: Update procedure, Encoding procedure, Decoding procedure. Golomb codes, Rice codes, Tunstall codes, Applications of Huffman coding: Loss less image compression, Text compression, Audio Compression.	**8L**
III	Coding of sequence, Generating a binary code, Comparison of Binary and Huffman coding, Applications: Bi-level image compression-The JBIG standard, JBIG2, Image compression. Dictionary Techniques: Introduction, Static Dictionary: Diagram Coding, Adaptive Dictionary. The LZ77 Approach, The LZ78 Approach, Applications: File Compression-UNIX compress, Image Compression: The Graphics Interchange Format (GIF), Compression over Modems: V.42 bits, Predictive Coding: Prediction with Partial match (ppm): The basic algorithm, The ESCAPE SYMBOL, length of context, The Exclusion Principle, The Burrows-Wheeler Transform: Moveto- front	**8L**

	coding, CALIC, JPEG-LS, Multi-resolution Approaches, Facsimile Encoding, Dynamic Markoy Compression.	
IV	Distortion criteria, Models, Scalar Quantization: The Quantization problem, Uniform Quantizer, Adaptive Quantization, Non uniform Quantization.	**8L**
V	Advantages of Vector Quantization over Scalar Quantization, The Linde-Buzo-Gray Algorithm, Tree structured Vector Quantizers. Structured Vector Quantizers.	**8L**

Reference / Text Books:

1. Khalid Sayood, Introduction to Data Compression, Morgan Kaufmann Publishers.
2. Elements of Data Compression, Drozdek, Cengage Learning.
3. Introduction to Data Compression, Second Edition, Khalid Sayood, The Morgan aufmann Series
4. Data Compression: The Complete Reference 4th Edition by David Salomon, Springer.
5. Text Compression1st Edition by Timothy C. Bell Prentice Hall.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	10
3) Assignments	-
4) Research Project Report / Seminar On Research Project Report	10
5) ESE	100
Total:	**150**

Prerequisites for the course: Image Processing

Course Learning Outcomes:

After completing the course, students should be able to:

1. Explain the basic concepts of Compression Techniques.
2. Explain different models.
3. Apply coding algorithm Techniques.
4. Apply Applications like Bi-level image compression, JBIG standard, JBIG2, Image compression and Dictionary Techniques.
5. Explain different Models and Scalar Quantization.
6. Compare Vector Quantization and Scalar Quantization.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B.Tech CSE**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 3** **Practical: 0**	**Subject: Universal Human Values & Professional Ethics**
Course Code: UVE-601	**Title: Universal Human Values & Professional Ethics**

Course Objectives:
The Student will Learn:

1. To reinstate the rich cultural legacy and human values of which we are thecustodians.
2. To focus on professional ethics which are broader indicators of desirable actions vis-à-vis undesirable actions.
3. To lay down broader guidelines of values and ethics for internal and externalstakeholders.
4. To suggest operational guidelines for value-based and ethical practices in the higher educational institutions leading to implementation and monitoring.
5. To indicate the outcomes of creating a value-based and ethical culture inHEIs.
6. To suggest indicative reinforcement programm for nurturing humanvalues and ethics in HEIs.

Nature of Paper: Elective Paper

Minimum Passing Marks/Credits: 40% Marks / 3 Credits

L:3
T:0
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (3Hrs./Week=3Credits)

Unit	Contents	No. of Lectures Allotted
I	**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education:** Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.	**8L**
II	**Understanding Harmony in the Human Being - Harmony in Myself** Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics	**8L**

	and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.	
III	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship** Understanding harmony in the Family- the basic unit of human interaction, Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha)- from family to world family!. Universal Human Values of truth (Satya), nonviolence, love (Prem), Peace (Shanti) and righteous conduct (dharma).	**8L**
IV	**Understanding Harmony in the Nature and Existence - Whole existence as Co-existence** Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.	**8L**
V	**Implications of the above Holistic Understanding of Harmony on Professional Ethics** Natural acceptance of human values, Definiteness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations. **Workshop on Life Skills**	**8L**

Reference / Text Books:

1. R R Gaur, R Sangal, G P Bagaria, 2009, a Foundation Course in Human Values and Professional Ethics.
2. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA

3. E.F. Schumacher, 1973, small is Beautiful: a study of economics as if people mattered, Blond& Briggs, Britain.
4. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991.
5. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
6. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	10
2) Presentations /Seminar	-
3) Assignments	05
4) Research Project Report/Seminar On Research Project Report	-
5) ESE	35
Total:	**50**

Prerequisites for the course: NIL

Course Learning Outcomes:

After completing the course, students should be able to:

1. Explain learning process for holistic development.
2. Define Impeccable governance.
3. Explain Effective institutional management.
4. Use Well laid system of rewards and chastisement.
5. Analyse Institutional climate where 'rights' enjoy and 'wrongs' are discouraged.
6. Development of Humanistic, Ethical, Constitutional and Universal Human Values.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B.Tech CSE**	**Year: III** **Semester: VI**
Credits: 2 **Theory: 0** **Practical:2**	**Subject: Computer Networks lab**
Course Code: SECS-361P	**Title: Computer Networks lab**

Course Objectives:
The Student will Learn:

- To understand the Implementation of Stop and Wait Protocol and Sliding Window Protocol.
- To understand the concept of ARP/RARP protocols.
- To understand creation ofa socket or HTTP for web page
- To understand sub netting and applications using TCP and UDP Sockets.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 2 Credits

L:0
T:1
P:3 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Implementation of Stop and Wait Protocol and Sliding Window Protocol.	**1L**
II	Study of Socket Programming and Client – Server model	**1L**
III	Write a code simulating ARP /RARP protocols.	**1L**
IV	Write a code simulating PING and TRACEROUTE commands	**1L**
V	Create a socket for HTTP for web page upload and download.	**1L**
VI	Write a program to implement RPC (Remote Procedure Call)	**1L**
VII	Perform a case study about the different routing algorithms to select the network path with its optimum and economical during data transfer. i. Link State routing ii. Flooding iii. Distance vector	**1L**
VIII	To learn handling and configuration of networking hardware like RJ-45 connector, CAT-6 cable, crimping tool, etc.	**1L**
IX	Configuration of router, hub, switch etc. (using real devices or simulators)	**1L**
X	Network packet analysis using tools like Wire shark, tcpdump, etc	**1L**
XI	Network simulation using tools like Cisco Packet Tracer, NetSim, OMNeT++, NS2, NS3, etc.	**1L**
XII	Socket programming using UDP and TCP (e.g., simple DNS, data & time client/server, echo client/server, iterative & concurrent servers)	**1L**

Reference / Text Books:

1. Behrouz Forouzan,"Data Communication and Networking", Mc Graw Hill.
2. Andrew Tanenbaum "Computer Networks", Prentice Hall.
3.William Stallings,"Data and Computer Communication", Pearson.

4. Kurose and Ross, "Computer Networking-A Top-Down Approach", Pearson.
5. Peterson and Davie,"Computer Networks : A Systems Approach", Morgan Kaufmann.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	30
Total:	**50**

Prerequisites for the course:

Course Learning Outcomes:

After completing the course, students should be able to:

1. Simulate different network topologies.
2. Implement various farming methods of Data Link Layer.
3. Implement various Error and flow control techniques.
4. Implement network routing and addressing techniques.
5. Implement transport and security mechanisms.
6. Implement Socket programming using UDP and TCP.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B.Tech CSE**	**Year: III** **Semester: VI**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Compiler Design Lab**
Course Code: SECS-362P	**Title: Compiler Design Lab**

Course Objectives:
The Student will Learn:

- To understand the different phases and passes of compiler and eventually recognize patterns, tokens and regular expressions.
- To understand the concept of parsers and construct the parsing tables.
- To understand and create the intermediate code

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 2 Credits

L:
T:
P:3 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
Practical-1	Design and implement a lexical analyzer for given language using C and the lexical analyzer should ignore redundant spaces, tabs and new lines.	**1L**
Practical-2	Implementation of Lexical Analyzer using Lex Tool	**1L**
Practical-3	Generate YACC specification for a few syntactic categories. a) Program to recognize a valid arithmetic expression that uses operator +, –, * and /. b) Program to recognize a valid variable which starts with a letter followed by any number of letters or digits. c) Implementation of Calculator using LEX and YACC d) Convert the BNF rules into YACC form and write code to generate abstract syntax tree	**1L**
Practical-4	Write program to find ε – closure of all states of any given NFA with ε transition.	**1L**
Practical-5	Write program to convert NFA with ε transition to NFA without ε transition.	**1L**
Practical-6	Write program to convert NFA to DFA	**1L**
Practical-7	Write program to minimize any given DFA.	**1L**
Practical-8	Develop an operator precedence parser for a given language.	**1L**
Practical-9	Write program to find Simulate First and Follow of any given grammar.	**1L**
Practical-10	Construct a recursive descent parser for an expression	**1L**

Reference / Text Books:

1. K. Muneeswaran, Compiler Design, First Edition, Oxford University Press.
2. J.P. Bennet, "Introduction to Compiler Techniques", Second Edition, Tata McGraw-Hill, 2003.
3. Henk Alblas and Albert Nymeyer, "Practice and Principles of Compiler Building with C", PHI, 2001.
4. Aho, Sethi & Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education.
5. V Raghvan, " Principles of Compiler Design", TMH.
6. Kenneth Louden," Compiler Construction", Cengage Learning.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	30
Total:	**50**

Prerequisites for the course:

Course Learning Outcomes:

After completing the course, students should be able to:

1. Recognize patterns, tokens & regular expressions for lexical analysis.
2. Implement Lexical analyzer for source language using C and LEX or YACC tools
3. To analyze and construct top down and bottom up parsers.
4. To evaluate and create the intermediate code
5. To create machine code from the intermediate code format.
6. To Construct a recursive descent parser for an expression

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VII

Programme: UG (R) **Class: B-Tech**	**Year: IV** **Semester: VII**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Distributed System**
Course Code: SECS-471	**Title: Distributed System**

Course Objectives:

- To understand theoretical concept of distributed system and message passing system.
- To understand the concepts of Mutual Exclusion and classification of algorithm and Distributed deadlock**.**
- To understand theoretical concepts of Agreement Protocol and distributed Resource Management**.**
- To get knowledge failure recovery in distributed system and, fault tolerance services.
- To understand the concepts of transaction and concurrency control and Replication Process and error recovery

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 3 (In Hours/Week)
Theory – 3 Practical- 3

Unit	Contents	No. of Lectures Allotted
I	Characterization of Distributed Systems: Introduction, Examples of distributed Systems, Resource sharing and the Web Challenges. Architectural models, Fundamental Models. Theoretical Foundation for Distributed System: Limitation of Distributed system, absence of global clock, shared memory, Logical clocks, Lamport's & vectors logical clocks. Concepts in Message Passing Systems: causal order, total order, total causal order, Techniques for Message Ordering, Causal ordering of messages, global state, and termination detection.	8
II	Distributed Mutual Exclusion: Classification of distributed mutual exclusion, requirement of mutual exclusion theorem, Token based and non-token based algorithms, performance metric for distributed mutual exclusion algorithms. Distributed Deadlock Detection: system model, resource Vs communication deadlocks, deadlock prevention, avoidance, detection & resolution, centralized dead lock detection, distributed dead lock detection, path pushing algorithms, edge chasing algorithms.	8
III	Agreement Protocols: Introduction, System models, classification of Agreement Problem, Byzantine agreement problem, Consensus problem, Interactive consistency Problem, Solution to Byzantine Agreement problem, Application of Agreement problem, Atomic Commit in Distributed Database system. Distributed Resource Management: Issues in distributed File Systems,	8

	Mechanism for building distributed file systems, Design issues in Distributed Shared Memory.	
IV	Failure Recovery in Distributed Systems: Concepts in Backward and Forward recovery, Recovery in Concurrent systems, Obtaining consistent Checkpoints, Recovery in Distributed Database Systems. Fault Tolerance: Issues in Fault Tolerance, Fault - tolerant services, Commit Protocols, Voting protocols, Dynamic voting protocols.	8
V	Transactions and Concurrency Control: Transactions, Nested transactions, Locks, Optimistic Concurrency control, Timestamp ordering, Comparison of methods for concurrency control. Distributed Transactions: Flat and nested distributed transactions, Atomic Commit protocols, Concurrency control in distributed transactions, Transaction recovery. Replication: System model and group communication, highly available services, Transactions with replicated data.	8

Reference/ Text Books:

1. Singhal & Shivaratri, "Advanced Concept in Operating Systems", McGraw Hill.
2. Ramakrishna, Gehrke," Database Management Systems", McGraw Hill.
3. Vijay K.Garg Elements of Distributed Computing , Wiley.
4. Coulouris, Dollimore, Kindberg, "Distributed System: Concepts and Design", Pearson Education Tenanuanbaum, Steen," Distributed Systems", PHI.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Assignments	20
3) External Theory	100
Total:	**150**

Course Learning Outcomes:

1. Define the characterization of Distributed Systems, Theoretical Foundation for Distributed System and Concepts in Message Passing System.
2. Explain the Distributed Mutual Exclusion and Distributed Deadlock Detection.
3. To know about Shared Memory Techniques and have Sufficient knowledge about file access.
4. Apply the Agreement Protocols and Distributed Resource Management.
5. Analyze the Failure Recovery in Distributed Systems and Fault Tolerance.
6. Evaluate the Transactions and Concurrency Control, Distributed Transactions and Replication.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VII

Programme: UG **Class: B.Tech-CSE**	**Year: IV** **Semester: VII**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Distributed System Lab**
Course Code: SECS-471P	**Title: Distributed System Lab**

Course Objectives:

- To understand the principles & basic concepts of distributed systems.
- To understand the concepts of Fault Tolerance and failure recovery of resources in distributed system.
- To solve problems in distributed Mutual Exclusion using various algorithms and methods.
- To analyze different Protocols in Distributed Systems.
- To analyze different distributed system transactions and concurrency controls.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 2 Credits

L:
T:
P:3 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Program to implement non token based algorithm for Mutual Exclusion	2
II	Program to implement Lamport's Logical Clock	2
III	Program to implement edge chasing distributed deadlock detection algorithm.	2
IV	Program to implement locking algorithm.	2
V	Program to implement Remote Method Invocation.	2
VI	Program to implement Remote Procedure Call.	2
VII	Program to implement Chat Server.	2
VIII	Program to implement termination detection	2

Reference / Text Books:
Reference/ Text Books:

1. Singhal & Shivaratri, "Advanced Concept in Operating Systems", McGraw Hill.
2. Ramakrishna, Gehrke," Database Management Systems", McGraw Hill.
3. Vijay K.Garg Elements of Distributed Computing , Wiley.
4. Coulouris, Dollimore, Kindberg, "Distributed System: Concepts and Design", Pearson Education.
5. Tenanuanbaum, Steen," Distributed Systems", PHI.

If the course is available as Generic Elective then the students of following departments may opt it. 1.

Evaluation/Assessment Methodology

Max. Marks:50

1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-

3) Assignments	-
4) Research Project Report	-
Seminar On Research Project Report	-
5) ESE	30
Total:	**50**

Course Learning Outcomes:

1. Students will get the concepts of Inter-process communication
2. Students will get the concepts of Distributed Mutual Exclusion and Distributed Deadlock Detection algorithm.
3. To get knowledge in distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems.
4. Student will be able to implement Chat Server.
5. Student will be able to implement Lamport's Logical Clock
6. Student will be able to distributed deadlock detection algorithm.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

Programme: UG (R) **Class: B.Tech-CSE**	**Year: IV** **Semester: VIII**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Mobile Computing**
Course Code: SDCS-481	**Title: Mobile Computing**

Course Objectives:

- Students will be able to explain and discuss issues in mobile computing and illustrate overview of wireless telephony and channel allocation in cellular systems.
- Students will be able to explore the concept of Wireless Networking and Wireless LAN.
- Students will be able to analyze and comprehend Data management issues like data replication for mobile computers, adaptive clustering for mobile wireless networks and Disconnected operations.
- Students will be able to Identify Mobile computing Agents and state the issues pertaining to security and fault tolerance in mobile computing environment.
- Students will be able to compare and contrast various routing protocols and will identify and interpret the performance of network systems using Adhoc networks.

Nature of Paper: Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (In Hours/Week)
Theory - 3Practical- 0

Unit	Contents	No. of Lectures Allotted
I	Introduction and issues in mobile computing, Details of wireless telephony: details of cellular concept, GSM details, air-interface in GSM, channel structure in GSM, location management: HLR-VLR, hierarchical, handoffs, channel allocation in cellular systems, Review of CDMA and GPRS.	10
II	Overview of wireless networking, Overview of wireless LAN: Medium access control issues, Overview of IEEE802.11, Overview of Bluetooth technology, Overview of wireless multiple access protocols, Comparison of Transmission control protocol over wireless transmission control protocol, Explanation of wireless applications, data broadcasting, Overview of Mobile IP. WAP: Architecture, protocol stack, application environment and applications.	10
III	Discussion of data management issues, Overview of data replication for mobile computers, Overview of adaptive clustering for mobile wireless networks: File system and Disconnected operations.	10
IV	Concept of mobile agents, Concept of security and fault tolerance and overview of transaction processing in mobile computing environment.	10
V	AdHoc networks: Issues of localization, overview of medium access control issues, discussion of Routing protocols, Understanding global	10

	state routing(GSR),Destination sequenced distance vector routing (DSDV), Dynamic source routing (DSR), Ad Hoc on demand distance vector routing (AODV), Temporary ordered routing algorithm (TORA), Explanation of quality of service in Ad-hoc networks, applications.	

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Assignments	20
3) External Theory	100
Total:	**150**

Course Learning Outcomes:

1. Discussion of issues in mobile computing and over view of wireless telephony and allocation of channel in cellular networks.
2. Walkthrough through the concept of Wireless Networking and Wireless local area networks.
3. Data management issues like data replication for mobile computers, adaptive clustering for mobile wireless networks and Disconnected operations, analysis and comprehension.
4. Identify Mobile computing Agents and state the issues pertaining to security and fault tolerance in mobile computing environment.
5. Compare and contrast various routing protocols and will identify and interpret the performance of network systems using Ad-hoc networks.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

Programme: UG(R) **Class: B-Tech CSE**	**Year: IV** **Semester: VIII**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: INTERNET OF THINGS**
Course Code: SDCS-482	**Title: Internet of Things**

Course Objectives:

1. Vision and introduction to IOT.
2. Understand IOT market perspective.
3. Data and knowledge management and use of devices in IOT technology.
4. Understand the State of the art-IOT Architecture.
5. Understand real world IoT design, constraints, IoT Automation and Comeercial building automation in IoT.

Nature of Paper: Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (In Hours/Week)
Theory – 3 Practical- 0

Unit	Contents	No. of Lectures Allotted
I	Internet of Things (IoT): Vision, Definition, Conceptual Framework, Architectural view, technology behind IoT, IoT sources, M2M Communication, Examples of IoT. Design Principles for Connected Devices: IoT/M2M systems layers, design standardization, communication technologies, data enrichment, consolidation, ease of designing, affordability.	10
III	Wireless Medium access issues, medium access protocol survey, Survey routing protocols, Sensor deployment, Node discovery, Data aggregation & dissemination.	10
IV	Ardunio Platform Boards Anatomy, Ardunio IDE, coding, using emulator, using libraries, additions in ardunio, IoT programming using Arduino.	10
V	Development Challenges, Security Challenges, Other challenges in IoT Applications: Overview of Smart Metering, E-health, City Automation, Automotive Applications, home automation, smart cards, communicating data with H/W units, mobiles, tablets, Designing of smart street lights in smart city using IoT.	10

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Assignments	20
3) External Theory	100
Total:	**150**

Course Learning Outcomes:

1. Demonstrate basic concepts of IoT, and understand the principles and challenges in IoT implementation.
2. Understand the functioning of hardware devices and sensors used in IoT.
3. Network communication aspects and protocols used in IoTare part of analysis.
4. Apply IoT for developing real life applications using Ardunio programming.
5. Development of IoT infrastructure for popular applications.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

Programme: UG (R) **Class: B-Tech -CSE**	**Year: IV** **Semester: VIII**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: CLOUD COMPUTING**
Course Code: SDCS-483	**Title: CLOUD COMPUTING**

Course Objectives:

- Understand the basic principles of cloud computing.
- To study the basic technologies that forms the foundations of Big Data.
- To study the programming aspects of cloud computing with a view to rapid prototyping of complex applications.
- To understand the specialized aspects of big data including big data application, and big data analytics.
- To study different types Case studies on the current research and applications of the Hadoop and big data in industry

Nature of Paper: Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (In Hours/Week)
Theory - 3Practical- 0

Unit	Contents	No. of Lectures Allotted
I	Overview of Cloud Computing, history, definition and evolution, Underlying concept of Parallel and Distributed computing, Cloud Architecture, and its types. Business models built around cloud technology, Case studies of major players in Cloud Computing. Discussion of issues in Clouds, Eucalyptus, Nimbus, Open Nebula, and Cloud Sim.	10
II	Overview of Cloud Services, Software as a Service Platform, Infrastructure as a Service, Database as a Service, Monitoring as a Service, communication as services. Discussion of service providers such as Google, Amazon, Microsoft Azure, IBM, Sales force.	10
III	Collaborating Using Cloud Services such as Email Communication over the Cloud, Project Management, Calendar, Schedules, Word Processing, Presentation, Spreadsheet, Databases, Desktop, Social Networks, customer relationship management and Groupware.	10
IV	Virtualization, Need, Pros and cons, Types of Virtualization in cloud, System and Process VM, Virtual Machine monitor, machine, Interpretation and binary translation, Overview of HLL VM supervisors, Xen, KVM, VMware, Virtual Box, Hyper-V.	10
V	Security in Clouds and challenges, Software as a Service Security, Overview of Common Standards in cloud i.e The Open Cloud Consortium ,The Distributed management Task Force , Standards for application Developers, Standards for	10

	Messaging, Standards for Security, End user access to cloud computing, Discussion on Mobile Internet devices and the cloud. Overview of Hadoop, Map Reduce, Virtual Box. Discussion on Google App Engine and Programming Environment for Google App Engine	

Reference/ Text Book:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security, CRC Press, 2017.
3. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, ―Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
4. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.
5. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Assignments	20
3) External Theory	100
Total:	**150**

Course Learning Outcomes:

1. Student must be Able to understand the building blocks of Big Data.
2. Student must be able to articulate the programming aspects of cloud computing (map Reduce etc.).
3. Student must be able to understand the specialized aspects of big data with the help of different big data applications.
4. Student must be able to represent the analytical aspects of Big Data.
5. Student must be know the recent research trends related to Hadoop File System, Map Reduce and Google File System etc.
6. Student must be able to understand the Security in Clouds and challenges.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

Programme: UG(R) **Class: B.Tech (CSE)**	**Year: IV** **Semester: VIII**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Block chain Architecture Design**
Course Code: SDCS-484	**Title: Block chain Architecture Design**

Course Objectives:

- Understanding the core concepts of Block chain in details.
- Impart strong technical understanding of consensus protocols.
- Develop familiarity of current technologies, tools, and implementation strategies of block chain.
- Understand use of Hyperledger fabric tool and its implementation.
- Introduce application areas, current practices, and research activity.

Nature of Paper: Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (In Hours/Week)
Theory – 3 Practical- 0

Unit	Contents	No. of Lectures Allotted
I	Overview of block chain, Journey of Digital Money to Distributed Ledgers, Design parameters: Protocols, Security, Consensus, Permissions, Privacy. Architecture and Design of Block chain: Discussion on crypto primitives: Signature and Hash, Journey of Hash chain to Block chain, Primitive consensus mechanisms	10
II	Consensus protocol requirements, Proof of Work, Scalability aspects of Block chain consensus protocols, Permissioned Block chains Consensus protocols and their design goals.	10
III	Overview of Hyperledger Fabric and their components, Decomposing the consensus process, Chain code Design and Implementation Hyperledger Fabric, Beyond Chain code fabric SDK and Front End and working of Hyperledger composer tool	10
IV	Case study of Blockchain in Financial Software and Systems (FSS): (i) Settlements, (ii) KYC, (iii) Capital markets, (iv) Insurance Case study of Blockchain in trade/supply chain: (i) Provenance of goods, visibility, trade/supply chain finance, invoice management discounting, etc.	10
V	Case Study of Blockchain for Government: i) Digital identity, land records and other kinds of record keeping between government entities,	10

	(ii) public distribution system social welfare systems Blockchain Cryptography, Privacy and Security on Blockchain.	

Reference/ Text Book:

1. Mstering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos
2. Blockchain by Melanie Swa, O'Reilly
3. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric

Evaluation/Assessment Methodology	
	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Assignments	20
5) External Theory	100
Total:	**150**

Course Learning Outcomes:

1. Basic understanding of Block chain architecture along with its primitive.
2. Requirements for basic protocol along with scalability aspects.
3. We design and deploy the consensus process using frontend and backend.
4. Application of Block chain techniques for different cases like Finance, Trade/Supply and Government activities.
5. Design and deploy the consensus process using frontend and backend.
6. Apply Block chain techniques for different use cases like Finance, Trade/Supply and Government activities.

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Evaluation Scheme

Artificial Intelligence & Machine Learning

Evaluation Scheme – Bachelor of Technology (Artificial Intelligence & Machine Learning)
Year: I / Semester: I

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	ENAS-111	MATHEMATICAL THINKING WITH CALCULUS AND LINEAR ALGEBRA	Th	Core-1	3	1	0	4	30	20	50	100	150
2.	ENAS-112	MODERN PHYSICS IN ENGINEERING	Th	Core -2	3	1	0	4	30	20	50	100	150
	ENEE-111	ELECTRICAL & ELECTRONICS IN THE MODERN WORLD											
3.	ENAI-111	DECODING DATA : LEARN AI, ML, DS & ANALYTICS	Th	Core -3	3	1	0	4	30	20	50	100	150
4.	ENCS-111	STRUCTURED PROGRAMMING AND PROBLEM SOLVING IN C	Th	VAC-1	3	1	0	4	30	20	50	100	150
5.	ENAS-114	PROFESSIONAL COMMUNICATION AND DIGITAL FLUENCY	Th	AECC-1	3	1	0	4	30	20	50	100	150
	ENHU -112	ENVIRONMENT, ECOLOGY AND SUSTAINABILITY		AECC-2									
6.	ENAS-112P	MODERN PHYSICS IN ENGINEERING LAB	P	LAB-1	0	0	2	1	0	15	15	35	50
	ENEE-111P	ELECTRICAL & ELECTRONICS IN THE MODERN WORLD LAB											
7.	ENCS-111P	PROGRAMMING WITH C LAB: HANDS ON LOGIC BUILDING	P	LAB-2	0	0	2	1	0	15	15	35	50
8.	ENAS-114P	PROFESSIONAL COMMUNICATION AND DIGITAL FLUENCY LAB	P	LAB-3	0	0	2	1	0	15	15	35	50
	ENHU -112P	ENVIRONMENT, ECOLOGY AND SUSTAINABILITY LAB											
9.	ENAI-111P	DECODING DATA : LEARN AI ,ML, DS & ANALYTICS LAB	P	SEC-1	0	0	2	2	0	15	15	35	50

10.	ENPH -111	SPIRITUAL AND CULTURAL HERITAGE: INDIAN EXPERIENCE	P	AC	0	0	0	NC*	0	25*	25*	0	25*
11.	NECC -112*	UNIVERSITY SOCIAL RESPONSIBILITY - COMMUNITY OUTREACH	P	AC	0	0	0	NC*	0	25*	25*	0	25*
12.	SPNC-111*	SPORTS	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**15**	**5**	**8**	**25**	**150**	**160**	**310**	**640**	**950**

Th- Theory paper, P-Practical, L-Lecture, T-Tutorials, C-Credit, AECC – Ability Enhancement Compulsory Course, AC – Audit Courses, NC*-No Credit Course, CT – Class Test (Sessional Examinations), TA – Teacher's Assessment, ESE – End Semester Examinations.
University Social Responsibility& Sports - Community Outreach and Sports, Spiritual And Cultural Heritage: Indian Experience are Non-Credit Qualifying Courses. Their marks will not be added in final marks.

Note: NCC Will be offered as General Elective.

Evaluation Scheme – Bachelor of Technology (Artificial Intelligence & Machine Learning)
Year: I / Semester: II

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	ENAS-121	APPLIED DIFFERENTIAL EQUATIONS	Th	Core-4	3	1	0	4	30	20	50	100	150
2.	ENEE-121	ELECTRICAL & ELECTRONICS IN THE MODERN WORLD	Th	Core-5	3	1	0	4	30	20	50	100	150
	ENAS-122	MODERN PHYSICS IN ENGINEERING											
3.	ENCS-122	SMART & SECURE TECHNOLOGIES	Th	Core-6	3	1	0	4	30	20	50	100	150
4.	ENAI-121	DATA ANALYSIS USING PYTHON	Th	VAC-2	3	1	0	4	30	20	50	100	150
5.	ENAS-124	PROFESSIONAL COMMUNICATION AND DIGITAL FLUENCY	Th	AECC-2	3	1	0	4	30	20	50	100	150
	ENHU -122	ENVIRONMENT, ECOLOGY AND SUSTAINABILITY		AECC-1									
6.	ENEE-121P	ELECTRICAL & ELECTRONICS IN THE MODERN WORLD LAB	P	LAB-5	0	0	2	1	0	15	15	35	50
	ENAS-122P	MODERN PHYSICS IN ENGINEERING LAB											
7.	ENAI-121P	DATA ANALYSIS USING PYTHON LAB	P	LAB-6	0	0	2	2	0	15	15	35	50

8.	ENAS-124P	PROFESSIONAL COMMUNICATION AND DIGITAL FLUENCY LAB	P	LAB-7	0	0	2	1	0	15	15	35	50
	ENHU -122P	ENVIRONMENT, ECOLOGY AND SUSTAINABILITY LAB											
9.	ENME-121P	RAPID PROTOTYING LAB	P	LAB-8	0	0	2	2	0	15	15	35	50
10.	ENHW-121	HEALTH AND WELLNESS	P	AC	0	0	0	NC*	0	25*	25*	0	25*
11.	NECC-121*	INDUSTRIAL VISIT / SEMINAR ON THE REPORT OF VISIT	P	AC	0	0	0	NC*	0	25*	25*	0	25*
12.	NECC -122*	UNIVERSITY SOCIAL RESPONSIBILITY - COMMUNITY OUTREACH	P	AC	0	0	0	NC*	0	25*	25*	0	25*
13.	SPWC-121	SPORTS	P	LAB-9	0	0	2	1	0	0	0	25	25
Total					**15**	**5**	**10**	**27**	**150**	**160**	**310**	**665**	**975**

Th- Theory paper, P-Practical, L-Lecture, T-Tutorials, C-Credit, AECC – Ability Enhancement Compulsory Course, AC – Audit Courses, NC*- Non Credit Course, CT – Class Test (Sessional Examinations), TA – Teacher's Assessment, ESE – End Semester Examinations.
University Social Responsibility - Community Outreach and Sports, Industrial Visit, Health and Wellness are Non-Credit Qualifying Courses. Their marks will not be added in final marks.

Note: NCC Will be offered as General Elective.

Evaluation Scheme – Bachelor of Technology (Artificial Intelligence & Machine Learning)
Year: II / Semester: III

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	RTAS-231	Engineering Mathematics-III	Th	Core 7	3	1	0	4	30	20	50	100	**150**
2.	RTCS-231	Operating System	Th	Core 8	3	1	0	4	30	20	50	100	**150**
3.	RTAI-231	Data Visualization	Th	Core 9	3	1	0	4	30	20	50	100	**150**
4.	RTAI -232	Statistical Modeling and Data Reasoning with Python	Th	Core 10	3	1	0	4	30	20	50	100	**150**
5.	RSAI-231	Digital Logic Circuit	Th	SEC-3	3	0	0	2	10	5	15	35	**50**
6.	RTCS-231P	Operating System Lab	P	Lab-11	0	0	3	2	0	15	15	35	**50**
7.	RTAI-231P	Data Visualization Lab	P	Lab-12	0	0	3	2	0	15	15	35	**50**
8.	RTAI-232P	Statistical Modeling and Data Reasoning with Python Lab	P	Lab-13	0	0	3	2	0	15	15	35	**50**
9.	RSAI-231P	Switching Theory Lab	P	AECC-3	0	0	3	2	0	15	15	35	**50**

10.	*NECC-232	University Social Responsibility - Community Outreach	P	AC	0	0	0	NC*	0	25*	25*	0	25*
11.	*SPT-231	Sports	P	AC	0	0	0	NC*	0	50*	50*	0	50*
Total					**15**	**04**	**12**	**26**	**130**	**145**	**275**	**575**	**850**

Th- Theory, L-Lecture, T-Tutorials, P-Practical (Labs), C-Credit, CT-Class Test (Sessional), TA-Teacher's Assessment (Attendance, Assignments, Tutorials, Class Tests, Quiz etc.), ESE-End Semester Examinations, NC*-Non-Credit Course, AC-Audit Course, SEC – Skill Enhancement Course.

NECC-232*, & SPT-231* are Non-credit courses and will be evaluated on the basis of a report presented by the student of his/her industrial visits, social visits ,awareness campaigns, rallies and participation in sports activities respectively during the semester. Student needs to qualify it but the marks will not be added in total marks.

Note: NCC is offered as General Elective.

Evaluation Scheme – Bachelor of Technology (Artificial Intelligence & Machine Learning)
Year: II / Semester: IV

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	RTAI-241	Machine Learning and Pattern Recognition	Th	Core 11	3	1	0	4	30	20	50	100	**150**
2.	RTAI -242	AI Product Development and Deployment	Th	Core 12	3	1	0	4	30	20	50	100	**150**
3.	RTCS-242	Data Structure Using C	Th	Core 13	3	1	0	4	30	20	50	100	**150**
4.	IEMM-402/ ASNL-402	**VAC-3**	Th	VAC- 3	3	0	0	2	10	5	15	35	**50**
5.	RDCS-241 RDCS-244	**DSE-I**	Th	DSE-1	3	1	0	4	30	20	50	100	**150**
6.		Generic Elective-I	Th	GE-1	4	0	0	4	30	20	50	100	**150**
7.	RTAI-241P	Machine Learning and Pattern Recognition Lab	P	Lab-14	0	0	3	2	0	15	15	35	**50**
8.	RTAI -242P	AI Product Development and Deployment Lab	P	Lab-15	0	0	3	2	0	15	15	35	**50**
9.	RTCS-242P	Data Structure Using C Lab	P	Lab-16	0	0	3	2	0	15	15	35	**50**
10.	NECC-241	Industrial Visit/Seminar/Presentation of the report of visit	P	AC	*0*	*0*	*0*	*NC**	*0*	*25**	*25**	*0*	*25**
11.	NECC-242	University Social Responsibility - Community Outreach	P	AC	*0*	*0*	*0*	*NC**	*0*	*25**	*25**	*0*	*25**
12.	SPT-PC-111	Sports	P	Lab 17	*0*	*0*	*3*	**2**	0	15	15	35	**50**
Total					**19**	**4**	**12**	**30**	**160**	**165**	**325**	**675**	**1000**
#Minor Certificate Paper-I					3	1	0	4	30	20	50	100	150

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessional), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, DSE-Discipline Specific Elective, SEC : Skill Enhancement Course, Th- Theory, ESE- End Semester Examination, AC- Audit course *Note: NECC-241, NECC-242 & SPT-241 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies & participation in sports activity respectively during the semester. Student needs to qualify it but the marks will not be added in total marks	
Discipline Specific Electives -I	1. RDCS-241 OOPs 2. RDCS-242 Data Analytics 3. RDCS-243 Distributed System 4. RDCS-244 Computer Graphics
Generic Electives-I	This subject will be opted by student from other School of the IIMT University
Value Added Course-3	1. IEMM-402 Indian Ethos and Modern Management 2. ASNL-402 Ancient Sanskrit Language (Central Sanskrit University, Delhi)

Most Important regarding Internship: A minimum of 4-5 weeks internship is to be completed during summer break & its assessment will be done in 5th Semester.

#Minor Certification will be choice based and the student choosing any minor certification course has to clear all the three papers in three semesters (IV/ V/ VI Semester).

Note: NCC is offered as General Elective.

Evaluation Scheme – Bachelor of Technology (Artificial Intelligence & Machine Learning)
Year: III / Semester: V

S. No	Subject Code	Subject Name	Evaluation Scheme									
			Periods			Internal Marks			External Marks		Total Marks	Credits
			L	T	P	CT	TA	IP	ET	EP		
1	SECS-351	Design and Analysis of Algorithm	3	1	0	30	20	0	100	0	**150**	**4**
2	SEAIML-351	Deep Learning Lab with Python, Tensor Flow and Keras	3	1	0	30	20	0	100	0	**150**	**4**
3	SEAIML-352	Neural Networks and Deep Learning Computer Networks	3	1	0	30	20	0	100	0	**150**	**4**
4	SDAIML-351-4	DSE-II	3	1	0	30	20	0	100	0	**150**	**4**
5	SEAIML-351P	Deep Learning Lab with Python, Tensor Flow and Keras Lab	0	0	3	0	0	20	0	30	**50**	**2**
6	SEAIML-352P	Neural Networks and Deep Learning Computer Networks Lab	0	0	3	0	0	20	0	30	**50**	**2**
7	SECS-351P	Design and Analysis of Algorithm Lab	0	0	3	0	0	20	0	30	**50**	**2**
8	SEAIML-354P	Internship	0	0	2	0	0	50	0	0	**50**	**2**
9	NECC-351	Research Project-1	*0*	*0*	*2*	*0*	*0*	*50**	*0*	*0*	*50**	*NC**
10	NECC-352	University Social Responsibility	*0*	*0*	*0*	*0*	*0*	*25**	*0*	*0*	*25**	*NC**
11	SPT-351	SPORTS	*0*	*0*	*0*	*0*	*0*	*50**	*0*	*0*	*50**	*NC**
		Grand Total	**12**	**04**	**13**	**120**	**80**	**110**	**400**	**90**	**800**	**24**

L- Lecture, T- tutorials, P- Practical (Labs), CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), IP- Internal Practical, ET- External Theory, EP- external Practical, NC- Non Credit Course

*Note: NECC-351, NECC-352 & SPT-351 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of social visits/awareness campaigns/ Research Project/Industry Training/Internship Survey/ awareness rallies & participation in sports activity respectively during the semester. Student needs to qualify it but the marks will not be added in total marks

Discipline Specific Elective-II: 1.Discrete Structures & Theory of Logic 2.Database Management System3.Application of Soft Computing4.Augmented & Virtual Reality

Evaluation Scheme – Bachelor of Technology (Artificial Intelligence & Machine Learning)
Year: III / Semester: VI

S. No	Subject Code	Subject Name	Evaluation Scheme								Total Marks	Credits
			Periods			Internal Marks			External Marks			
			L	T	P	CT	TA	IP	ET	EP		
1	SEAIML-361	Data Science Tools and Techniques	3	1	0	30	20	0	100	0	**150**	**4**
2	SEAIML-362	Natural Language Processing	3	1	0	30	20	0	100	0	**150**	**4**
3	SDAIML-361-4	DSE-III	3	1	0	30	20	0	100	0	**150**	**4**
4	UVE-601	Universal Human Values & Professional Ethics	3	0	0	10	05	0	35	0	50	**3**
5	SEAIML-363P	Mini Project	0	0	3	0	0	50	0	0	**50**	**2**
6	SEAIML-361P	Data Science Tools and Techniques Lab	0	0	3	0	0	20	0	30	**50**	**2**
7	SEAIML-362P	Natural Language Processing Lab	0	0	3	0	0	20	0	30	**50**	**2**
8	NECC-365	MOOCS (SWAYAM/NPTEL)	0	0	2	0	0	50	0	0	**50**	**2**
9	NECC-361	Research Project-2	*0*	*0*	*2*	*0*	*0*	*50**	*0*	*0*	*50**	*NC**
10	NECC-362	University Social Responsibility	*0*	*0*	*0*	*0*	*0*	*25**	*0*	*0*	*25**	*NC**
11	*SPT-361	SPORTS	*0*	*0*	*0*	*0*	*0*	*50**	*0*	*0*	*50**	*NC**
		Grand Total	**12**	**03**	**13**	**100**	**65**	**140**	**335**	**60**	**700**	**23**

L- Lecture, T- tutorials, P- Practical (Labs), CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), IP- Internal Practical, ET- External Theory, EP- external Practical, NC- Non-Credit Course

*Note: NECC-361, NECC-362 & SPT-361 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies & participation in sports activity respectively during the semester. Student needs to qualify it but the marks will not be added in total marks

Discipline Specific Elective-III: 1. Computer Networks 2. Compiler Design 3. Human Computer Interface 4. Big Data

Evaluation Scheme – Bachelor of Technology (Artificial Intelligence & Machine Learning)
Year: IV / Semester: VII

S. No	Subject Code	Subject Name	Evaluation Scheme									
			Periods			Internal Marks			External Marks		Total Marks	Credits
			L	T	P	CT	TA	IP	ET	EP		
1	SEAIML-471	DevOps	3	1	0	30	20	0	100	0	**150**	**4**
2		GE-2	3	1	0	30	20	0	100	0	**150**	**4**
3	SEAIML-471P	Data Visualization Lab	0	0	3	0	0	20	0	30	**50**	**2**
4	SEAIML-473P	Minor Project	0	0	8	0	0	40	0	60	**100**	**4**
5	SEAIML-474P	Internship	0	0	2	0	0	50	0	0	**50**	**2**
6	NECC-475	MOOCS (SWAYAM/NPTEL)	0	0	2	0	0	50	0	0	**50**	**2**
7	NECC-472	University Social Responsibility	*0*	*0*	*0*	*0*	*0*	*25**	*0*	*0*	*25**	*NC**
8	SPT-471	SPORTS	*0*	*0*	*0*	*0*	*0*	*50**	*0*	*0*	*50**	*NC**
		Grand Total	**6**	**02**	**15**	**60**	**40**	**160**	**200**	**90**	**550**	**18**

L- Lecture, T- tutorials, P- Practical (Labs), CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), IP- Internal Practical, ET- External Theory, EP- external Practical, NC- Non Credit Course

***Note:** NECC-352 & SPT-351 is a Non-creditcourses (Audit Courses) and will be evaluated on the basis of social visits/awareness campaigns/ awareness rallies & participation in sports activity respectively during the semester. Student needs to qualify it but the marks will not be added in total marks

Evaluation Scheme – Bachelor of Technology (Artificial Intelligence & Machine Learning)
Year: IV / Semester: VIII

S. No	Subject Code	Subject Name	Evaluation Scheme									
			Periods			Internal Marks			External Marks		Total Marks	Credits
			L	T	P	CT	TA	IP	ET	EP		
1		Generic Elective	3	1	0	20	10	0	70	0	**100**	**4**
2	SDAIML-481-4	DSE-IV	3	1	0	20	10	0	70	0	**100**	**4**
3	SEAIML-481P	Major Project	0	0	20	0	0	100	0	150	**250**	**10**
		Grand Total	**06**	**02**	**20**	**40**	**20**	**100**	**140**	**150**	**450**	**18**

L- Lecture, T- tutorials, P- Practical (Labs), CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), IP- Internal Practical, ET- External Theory, EP- external Practical, NC- Non-Credit Course	
*Note: NECC-352 & SPT-351 is a Noncredit course (Audit Courses) and will be evaluated on the basis of social visits/awareness campaigns/ awareness rallies & participation in sports activity respectively during the semester. Student needs to qualify it but the marks will not be added in total marks	
Discipline Specific Elective-IV	1. Mobile Computing 2. Internet of Things 3.Cloud Computing 4.Block chain Architecture Design

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CBCS: Statement of Credit distribution (w.e.f: Session 2024-25)

College/School: School of Engineering & Technology **Programme: B.Tech** **Duration: 8 Semester Annual/Semester: Semester**									**Credit range: 160-190 (Suggested by CBCS Committee)**		
COURSE	**CREDIT**	**SEMESTER**	**CORE COURSE Major**	**DSE Minor**	**AECC**	**SEC**	**GE (Th 4) Interdisciplinary**	**General Elective**	**Value Added Course (VAC)**	**Industrial Training/ Survey / Research Project**	**Total Credits**
No Exit Allowed	26	I	C-1 (4 Credit) C-2 (4 Credit)+P-01(1Credit) C-3 (4 Credit)+P-02(1Credit)		AECC-1 (4Credit)+ P-04 (1Credit)	SEC-1 P-(2 Credit)		NCC	VAC-1 (4 Credit) + P-9(1Credit)		26
	28	II	C-4 (4 Credit) C-5 (4 Credit)+P-05(1Credit) C-6 (4 Credit)+P-06(2Credit) P-8 (1 Credit)		AECC-2 (4Credit)+ P-04 (1Credit)	SEC-2 P-(2 Credit)		NCC	VAC-2 (4 Credit) + P-9(1Credit)		28
Certificate in Engineering	26	III	C-07(4 Credit) C-8 (4 Credit)+P-10(2 Credit) C-9 (4 Credit)+P-11(2 Credit) C-10 (4Credit)+P-12(2 Credit)		AECC-3 (P- 2Credit)	SEC-3 (2 Credit)		NCC			26
	28	IV	C-11(4 Credit) C-12 (4 Credit)+P-13(2 Credit) C-13 (4 Credit)+P-14(2 Credit) P-15(2 Credit)	DSE-1 (4 Credit)			GE-1 (4 Credit)	NCC	VAC-3 (2 Credit)		28

Diploma in Engineering	26	V	C-14 (4 Credit)+P-16(2 Credit) C-15 (4 Credit)+P-17(2 Credit) C-16 (4 Credit)+P-18(2 Credit)	DSE-2 (4 Credit)		SEC-4 (2 Credit)		NCC		INT-1 (2 Credit) RP-I (NC*)	26
	20	VI	C-17 (4 Credit)+P-19(2 Credit) C-18 (4 Credit)+P-20(2 Credit)	DSE-3 (4 Credit)	AECC-4 (2 Credit)	SEC-5 (2 Credit)		NCC		RP-II(NC*)	20
B.Tech (Degree)	18	VII	C-19 (4 Credit)+P-21(2 Credit)			SEC-6 (2 Credit)	GE-2 (4 Credit)	NCC		INT-2 (2 Credit) Minor Project (4 Credit)	18
	18	VIII		DSE-4 (4 Credit)			GE-3 (4 Credit)	NCC		Major Project (10 Credit)	18
			19(Th)*4(C) = 76 04(Pr)*01(C) = 04 13(Pr)*2(C) = 26 **Total = 106**	4(Th)*4(C) =16 **Total =16**	02(Th)*04(C)=8 02(Pr)*01(C)=02 01(Pr)*02(C)=02 01(Th)*02(C)=02 **Total =14**	02(Pr)*02(C)=4 04(Th)*02(C)=8 **Total =12**	03(Th)*04(C)=12 **Total =12**		02(Th)*04(C)=8 02(Pr)*01(C)=02 01(Th)*02(C) =02 **Total =12**	2+2+4+10=18 **Total =18**	**190**

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IIMTU-NEP Implementation: (w.e.f. Session 2024-25) **B.Tech (Artificial Intelligence & Machine Learning)**

Programme	Year	Semester (15) weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester	Prerequisite	Elective (For other faculty)
BACHELOR OF TECHNOLOGY – Artificial Intelligence & Machine Learning	FIRST YEAR	SEMESTER-I	i) Core-1 (Th.4C)	4	5	45	Engineering Mathematics –I	5		SOBST
			ii) AECC-1 (Th.4 C + P 1 C)	4 1	4 3	45 30	Effective Engineering Communication / Environment and Ecology Effective Engineering Communication Lab / Environment and Ecology Lab	5		SOAH
			iii) Core-2 (Th.4 C + P 1 C)	4 1	5 3	45 30	Engineering Physics / Engineering Chemistry Engineering Physics Lab / Engineering Chemistry Lab	5		SOBST
			iv) Core-3 (Th.4C)	4	5	45	Decoding Data : Learn AI ,ML, DS & Analytics	5		
			v) VAC-1 (Th.4 C + P 1 C)	4 1	5 3	45 30	Structured Programming and Problem Solving in C Structured Programming and Problem Solving in C lab	5		
			vi) SEC-1 (P 2C)	1	3	30	Decoding Data : Learn AI ,ML, DS & Analytics Lab			
			vii) Lab-4 (P 1 C)	1	3	30	Mechanical Workshop Lab / Engineering Graphics & Design Lab			SOBST
			viii) Audit Course	NC	-	-	University Social Responsibility - Community Outreach			
			ix) Audit Course	NC	-	-	Sports	5		

		SEMESTER – II	i) Core-4 (Th.4C)	4	5	45	Engineering Mathematics –II	5		SOBST
			ii) AECC-2 (Th.4 C+ P 1 C)	4 1	4 3	45 30	Environment and Ecology / Effective Engineering Communication Environment and Ecology Lab / Effective Engineering Communication Lab	5		SOAH
			iii) Core-5 (Th.4 C + P 1 C)	4 1	5 3	45 30	Engineering Chemistry/ Engineering Physics Engineering Chemistry Lab/ Engineering Physics Lab	5		SOBST
			iv) Core-6 (Th.4 C+ P 1 C)	4 1	5 3	45 30	Introduction to Electrical and Electronics Engineering Introduction to Electrical and Electronics Engineering Lab	5		
			v) VAC-2 (Th.4 C + P 1 C)	4 1	5 3	45 30	Data Analysis using Python Data Analysis using Python Lab	5		
			vi) Lab -9 (P 1 C)	1	3	30	Mechanical Workshop Lab / Engineering Graphics & Design Lab			SOBST
			vii) SEC-2 (P 2 C)	2	3	30	Advance Industrial training in 'C' Lab			
			viii) Audit Course	NC	-	-	Industrial Visit / Seminar on the report of visit			
			ix) Audit Course	NC	-	-	University Social Responsibility - Community Outreach			
			x) Lab-10 (SPT-PC-111)	2	3	30	Sports	5		
Program Outcome: PO1 - PO12 [ANNEXTURE-1]							**Program Specific Outcome:** PSO1 – PSO2 [ANNEXTURE-2]			

Note: A total of 8 Credits are mandatory to earn from NPTEL/Moocs/Coursera during 4 years of B.Tech Program.

Programme	Year	Semester (15) weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester	Prerequisite	Elective (For other faculty)
BACHELOR OF TECHNOLOGY – Artificial Intelligence &Machine Learning	SECOND YEAR	SEMESTER –III	i) Core-7 (Th 4C)	4	5	45	Engineering Mathematics-III	5		
			ii) Core-8 (Th 4C + P 2C)	4 2	5 3	45 30	Operating System Operating System Lab	5		
			iii) Core-9 (Th 4C + P 2C)	4 2	5 3	45 30	Data Visualization Data Visualization Lab	5		
			iv) Core-10 (Th 4C + P 2C)	4 2	5 3	45 30	Statistical Modeling and Data Reasoning with Python Statistical Modeling and Data Reasoning with Python Lab	5		
			v) AECC-3 (P 2 C)	2	3	30	Switching Theory Lab	5		
			vi) SEC-3 (Th2C)	2	3	30	Digital Logic Circuit	5		
			vii) Audit Course	NC	-	-	University Social Responsibility - Community Outreach			
			viii) Audit Course	NC	-	-	Sports			
		SEMESTER -IV	i) Core-11(Th.4C+ P. 2 C)	4 2	5 3	45 30	Machine Learning and Pattern Recognition Machine Learning and Pattern Recognition Lab	5		
			ii) Core-12 (Th. 4C + P. 2 C)	4 2	5 3	45 30	AI Product Development and Deployment AI Product Development and Deployment Lab	5		
			iii) Core-13 (Th. 4C + P. 2 C)	4 2	5 3	45 30	Data Structure Using C Data Structure Using C Lab	5		
			iv) VAC-3 (Th. 2 C)	2	3	30	1.Indian Ethos and Modern Management 2. Ancient Sanskrit Language (CSU Delhi)	5		
			iv) DSE-1 (Th.4C)	4	5	45	1. OOPs 2. Data Analytics 3. Distributed System 4. Computer Graphics	5		
			v) GE-1 (Th. 4C)	4	5	45	Generic Elective-I (To be opted from other school)			

			vi) Audit Course	NC	-	-	Industrial Visit/Seminar/Presentation of the report of visit			
			vii) Audit Course	NC	-	-	University Social Responsibility - Community Outreach			
			viii)Lab-17	2	3	30	**Sports**	5		
Program Outcome: PO1 - PO12 [ANNEXTURE-1]							**Program Specific Outcome:**PSO1 – PSO2 [ANNEXTURE-2]			

Note: Industrial Training of 4 Weeks/5Weeks to be completed between the semester break #Minor Certification Paper-I

Programme	Year	Semester (15 weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester)	Prerequisite	Elective (For other faculty)
BACHELOR OF TECHNOLOGY – Artificial Intelligence &Machine Learning	THIRD YEAR	SEMESTER – V (24 Cr.)	i) C16 (Th. 4 Cr. +P 2 Cr.)	4 2	4 3	48 36	Design and Analysis of Algorithm Design and Analysis of Algorithm Lab	5		
			ii) SEC-4(2 Cr.)	2 4	2 4	24 48	Internship 1.Discrete Structures & Theory of Logic			
			iii) DSE-2(Th. 4 Cr.)				2.Database Management System 3.Application of Soft Computing 4.Augmented & Virtual Reality	5		
			iv) Research Project/Industry Training/Internship Survey	NC			Research Project-I			
			i) C17 (Th. 4 Cr. + P 2 Cr.)	4 2	4 3	48 36	Deep Learning Lab with Python, Tensor Flow and Keras Deep Learning Lab with Python, Tensor Flow and Keras Lab	5		
			i) C18 (Th. 4 Cr. + P 2 Cr.)	4 2	4 3	48 36	Neural Networks and Deep Learning Neural Networks and Deep Learning Lab			

		SEMESTER – VI (23 Cr.)	i) C19(Th. 4 Cr. + P 2 Cr.)	4 2	4 3	48 36	Data Science Tools and Techniques Data Science Tools and Techniques Lab	5		
			ii) SEC-5(2 Cr.)	2	2	24	MOOCS (Swayam/ NPTEL)			
			iii) DSE-3(Th. 4 Cr.)	4	4	48	1. Computer Networks 2. Compiler Design 3.Human Computer Interface 4. Big Data	5		
			i) C20 (Th. 4 Cr. + P 2 Cr.)	4 2	4 3	48 36	Natural Language Processing Natural Language Processing Lab	5		
			i) AECC-3 (Th. 3Cr.)	3	3	36	Universal Human Values & Professional Ethics	5		
			ii) SEC-6(P 2 Cr.)	2	3	36	Mini Project			
			iii) Research Project/Industry Training/Internship Survey	NC			Research Project/Industry Training/Internship Survey			

Programme	Year	Semester (15 weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester)	Prerequisite	Elective (For other faculty)
BACHELOR OF TECHNOLOGY – Artificial Intelligence &Machine Learning	FOURTH YEAR	SEMESTER –VII (18 Cr.)	i) C23 (Th. 4 Cr + P 2 Cr.)	4 2	4 3	48 36	Dev Ops Data Visualization Lab	5		
			ii) SEC-5(2 Cr.)	2	2	24	MOOCS (SWAYAM/NPTEL)			
			iii) Project Lab (Minor)	4	8	96	Minor Project			
			iv) GE-2(Th. 4 Cr.)	4	4	48	***# To be selected from other School***	5		
			i) SEC-6(2 Cr.)	2	3	45	Internship			
		SEMESTER – VIII (18 Cr.)	i) Generic Elective (Th. 4Cr)	4	4	45	***# To be selected from other School***			
			ii) DSE-4(Th. 4 Cr.)	4	4	45	1. Mobile Computing 2. Internet of Things 3. Cloud Computing 4. Block chain Architecture Design			
			iii) Research Project (Industrial Training/ Internship Survey)	10	30	360	Major Project	5		
*Major Project report will be evaluated by external & internal examiners & Research topic may be selected from the main core paper										

Programme Outcome: (PO_1–PO_{12}): Annexure:1	Programme Specific Outcome: (PSO_1-PSO_2): Annexure:2
Note: Industrial Training of 4 Weeks/5Weeks to be completed between the semester break #Minor Certification Paper-II & III	
Note: Major Project report will be evaluated by external & internal examiners & Research topic may be selected from the main core paper	

ANNEXTURE-1

Program Outcomes:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and Research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

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ANNEXTURE-2

Program Specific Outcomes:

PSO1: Enabling students to learn continuously and to provide effective answers to new computational issues.

PSO2: Understand analyze data and create software to create computer-based systems of varying complexity that are designed effectively.

Format-3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech (CSE)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Mathematical Thinking with Calculus and Linear Algebra**
Course Code: ENAS-111	**Title: Mathematical Thinking with Calculus and Linear Algebra**

Course Objectives:

1. To gain the knowledge of differential calculus required for the field of engineering.
2. To deal with functions of several variables that is essential in optimizing the results of real life problems.
3. To understand Multiple integral tools to deal with engineering problems involving Surface area, volume etc.
4. To deal with vector calculus that is required in different branches of Engineering to graduate engineers.
5. To understand the essential tools of matrices and linear algebra, Eigen values and diagonalization in a Comprehensive manner are required.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total))

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Differential Calculus:** Rolle's Theorem, Mean Value Theorems, Successive Differentiation (nth order derivatives), Leibnitz theorem, Taylor's and Maclaurin's Theorems (without proof), Expansion of functions (standard forms),	9L
II	**Partial Differentiation:** Functions of several variables, Limit, Continuity, Partial derivatives, Euler's Theorem, Total derivative, Chain rule, Jacobians, Taylor's expansion for multivariable functions, Maxima and Minima of functions of two variables.	9L
III	**Integral Calculus:** Multiple integration: Double integral, Triple integral, Change of order of integration, Change of variables, Application: Areas and volumes.	9L
IV	**Vector Calculus:** Vector differentiation: Gradient, Curl and Divergence and their Physical interpretation, Directional derivatives. Vector Integration: Line integral, Surface integral, Volume integral, Gauss's Divergence theorem, Green's theorem and Stoke's theorem (without proof) and their applications	9L
V	**Linear Algebra:** Types of Matrices: Symmetric, Skew-symmetric and Orthogonal Matrices; Complex Matrices, Inverse and Rank of matrix	9L

	using elementary transformations, System of linear equations, Characteristic equation, Eigen values and eigenvectors, Cayley-Hamilton Theorem and its application, Diagonalization of a Matrix.	

Text Books:

1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*

Reference Books:

1. *E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.*
2. *Veerarajan T., Engineering Mathematics for first year, McGraw-Hill, New Delhi, 2008.*
3. *R K. Jain & S R K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House 2002*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	Understand the concept of differentiability and apply in the study of Successive differentiation, Leibnitz theorems and Partial differentiation.	**L2 & L3**
CO-2	Identify the application of partial differentiation and apply for evaluating maxima, minima, series and Jacobians.	**L3 &L4**
CO-3	Illustrate the working methods of multiple integral and apply for finding area, volume.	**L1& L3**
CO-4	Remember the concept of vector and apply for directional derivatives, tangent and normal planes. Also evaluate line, surface and volume integrals.	**L2 & L3**
CO-5	Remember the concept of matrices and apply for solving linear simultaneous equations.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	2	2	1	2	1	0	0	0	0	1	0
CO-3	2	2	0	1	1	0	0	0	0	0	0	2
CO-4	3	0	2	1	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech (CSE)**	**Year: I** **Semester: I/II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Modern Physics in Engineering**
ENAS-112/ENAS-122	**Title: Modern Physics in Engineering**

Course Objectives:

1. To know the concept of Interference and Diffraction.
2. To know the significance of Maxwell's equations in the Engineering applications of electromagnetic waves.
3. Explain Quantum Mechanics to understand wave particle dualism. Necessity of quantum mechanics to explore.
4. To understand the concept of Relativistic Mechanics.
5. To understand the Phenomenon of Fiber optics and Laser.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Wave Optics:** Interference: Basics of interference of light, coherent Sources, Conditions of Interference; Interference by division of wave front and amplitude (Interference due to thin film, Wedge shaped film and Newton's Rings). **Diffraction:** Fraunhoffer Diffraction Due Single slit, Diffraction Grating; Diffraction due to N slits, Rayleigh's criterion of resolution; absent spectra, dispersive Power of grating, Resolving power of Grating.	12L
II	**Electromagnetic:** Gauss law Ampere's law and displacement current; Equation of continuity; Maxwell's equations in Integral and Differential Forms; Electromagnetic Wave Propagation in Free Space and Conducting Media; Poynting Theorem	9L
III	**Quantum Mechanics:** Planck's concept (hypothesis), Compton Effect, Particle properties of wave: Matter Waves, Davisson Germer Experiment, Heisenberg Uncertainty Principle, Wave function, and Schrodinger equation (time dependent & independent), Particle in a 1-D box.	9L
IV	**Relativistic Mechanics:** Inertial and Non- Inertial Frames; Michelson-Morley Experiment; Postulates of Special Theory of Relativity; Galilean and Lorentz Transformation; Length Contraction and Time Dilation; Addition of Velocities; Mass Energy Equivalence and Variation of Mass with Velocity.	9L

V	**Laser:** Absorption of radiation, Spontaneous and stimulated emission of radiation, Population inversion, Einstein's Coefficients, Principles of laser action, Components of laser, Solid state Laser (Ruby laser) and Gas Laser (He-Ne laser), Laser applications	**6L**

Text Books:
1. Concepts of Modern Physics - AurthurBeiser (Mc-Graw Hill)
2. Introduction to Special Theory of Relativity- Robert Resnick (Wiley)
3. Engineering Physics: Theory and Practical- Katiyar and Pandey (Wiley India)

Reference Books:
1. *Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New)*
2. *Engineering Physics-Malik HK and Singh AK (McGrawHill)*

If the course is available as **Generic Elective**, then the students of following departments may opt it: NO

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Physics of Class 12

Course Learning Outcomes:

CO-1	Apply the principles of wave optics to analyze and predict light behavior in various scenarios.	**L3 & L4**
CO-2	Analyze and solve problems involving electromagnetic fields and waves in various contexts.	**L4**
CO-3	Remember and apply the principles of quantum mechanics to understand and predict the behavior of particles at the atomic and subatomic levels.	**L1 & L3**
CO-4	Understand the principles of relativistic mechanics to analyze and predict the behavior of objects moving at velocities close to the speed of light.	**L2 & L4**
CO-5	Understand and apply the principles of laser technology.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B. Tech. ME**	**Year: I** **Semester: I/II**
Credits: 4 **Theory: 4** **Practical: 0**	**SUBJECT: ENGINEERING CHEMISTRY**
Course Code: ENAS-113/ ENAS-123	**Title: ENGINEERING CHEMISTRY**

Course Objectives:

1. To enable the students to understand about the Chemistry of Atomic and Molecular structure, Chemistry of advanced Materials like Liquid crystals, Nanomaterials, Graphite & fullerenes, and Green Chemistry.
2. To enable the students to understand and apply the detailed concepts of spectroscopic techniques and stereochemistry to identify the compounds, element etc.
3. To enable the students to understand and apply the concepts related to Electrochemistry, Batteries, Corrosion and Chemistry of Engineering Materials like cement.
4. To enable the students to understand and apply detailed concepts of water source, water impurities, hardness of water and boiler troubles used in industry as well as analysis of coal & determination of calorific values.
5. To enable the students to understand detailed concepts related to polymers, Polymerization, Polymer Blends, Polymer Composites, and organometallic compounds.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total))

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Atomic and Molecular Structure:** Molecular orbitals of diatomic molecules (bond order, magnetic characters and numerical problems). **Chemistry of Advanced Materials:** ***Liquid Crystals;*** Introduction, Types and Applications of liquid crystals, industrially important materials used as liquid crystals. ***Graphite and Fullerene;*** Introduction, Structure and applications. ***Nanomaterials;*** Introduction, Preparation, characteristics of nanomaterials and applications of nanomaterials: Carbon Nano Tubes (CNT) and graphene. **Green Chemistry:** Introduction to green chemistry, 12 principles and importance of green Synthesis, Green Chemicals, Synthesis of typical organic compounds by conventional and Green routes (Adipic acid and Paracetamol), Environmental impact of Green chemistry on society.	**10L**
II	**Spectroscopic techniques and Applications:** Elementary idea and simple applications of Ultraviolet (UV) & Visible, fluorescence, Jablonski diagram, IR and Raman spectroscopy.	**8L**

	Stereochemistry: Optical isomerism in compounds without chiral carbon, Geometrical isomerism, Chiral Drugs.	
III	**Electrochemistry:** Nernst Equation and application, relation of EMF with thermodynamic functions (ΔH, ΔF and Δ S). Lead storage battery. **Corrosion**; causes, effects and its prevention. **Chemistry of Engineering Materials:** ***Cement;*** Constituents, manufacturing, hardening and setting, deterioration of cement, Plaster of Paris (POP).	**9L**
IV	**Water Analysis:** Hardness of water, Techniques for water softening (Lime-soda, Zeolite, Ion exchange resin and Reverse osmosis method). **Fuels:** classification of fuels, Analysis of coal, Determination of calorific value (Bomb calorimeter and Dulon's method).	**8L**
V	**Polymers:** Basic concepts of Polymer-Blend and composites, Conducting and biodegradable polymers. Preparation and application of some industrially important polymers (Buna-S, Buna-N, Neoprene, Nylon-6, nylon-6,6, Teflon, Lucite, Bakelite, and Terylene). **Organometallic Compounds:** General methods of synthesis of organometallic compounds (Grignard reagent and lithium aluminum hydride) and their applications.	**9L**

Reference Books:

1. Engineering Chemistry by Rath & Singh, 2nd Edition, Cengage Learning India Pvt. Ltd Delhi.
2. Engineering Chemistry by SS Dara, S Chand & Co Ltd
3. Engineering Chemistry by Jain & Jain, S. Chand & Comp, New Delhi
4. Engineering Chemistry by K. Sesha Maheswaramma, Pearson
5. Engineering Chemistry by OG Palanna, Mc Graw Hill Education, New Delhi
6. Engineering Chemistry by Shashi Chawala, Dhanpat Rai Publishing Comp, New Delhi

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NA**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: NA

Course Learning Outcomes: After completion of the course, the student should be able to:

CO-1	Understand about the principles of atomic and molecular structure, bonding and properties, chemistry of advanced materials like Liquid Crystals, Nanomaterials, Graphite, graphene & Fullerenes as well as the principles of green chemistry.	**L1 & L2**
CO-2	Apply the fundamental concepts of determination of structure with various spectral techniques and stereochemistry	**L2 & L3**

CO-3	Apply the theory of construction of electrodes, batteries and fuel cells and re-designing or new engineering products, and categorize the reasons for corrosion and study methods to control corrosion, and develop an understanding of the chemistry of cement.	**L3 & L2**
CO-4	Understand the sources, impurities and hardness of water, apply the concepts of determination of calorific values and analyze the coal.	**L2, L3 & L4**
CO-5	Understand the chemical structure of polymers and its effect on their various properties when used as engineering materials. Understanding the applications of specific polymers and organometallic compounds, applicable in industrial process.	**L1 & L2**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	3	2	2	2	2	0	0	0	0	2
CO-2	2	3	2	3	3	1	1	0	0	0	0	2
CO-3	3	3	3	3	2	2	2	0	1	0	0	1
CO-4	3	3	3	2	2	2	2	0	0	0	0	1
CO-5	3	3	2	2	2	2	2	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech (CSE)**	**Year: I** **Semester: I/II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: ELECTRICAL & ELECTRONICS IN THE MODERN WORLD**
Course Code: ENEE-111/ ENEE-121	**Title: ELECTRICAL & ELECTRONICS IN THE MODERN WORLD**

Course Objectives:

1. To provide students with a foundation in basic electrical and electronic principles.
2. To develop the ability to simplify complex DC networks
3. To introduce semiconductors and devices used in computers and modern electronics.
4. To connect electronics concepts with applications in computing, IoT, and automation.
5. To enable students to perform simple hands-on experiments using electronic components and microcontrollers.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total))

L: 3	**T:** 1	**P:** 0	**C:** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Fundamentals of Electrical & Circuits** • Voltage, current, resistance, power (basic quantities) • Passive Components: Resistors, capacitors, inductors: functions, uses, and color coding • Ohm's Law and simple circuit calculations • Series and parallel combination of resistance, • AC vs DC supply (very basic introduction) • Application: Power supply in computers, mobile	9L
II	**DC Circuits** • Introduction to DC circuits, • Star-Delta conversion. • Kirchhoff's laws, • Mesh and nodal methods of analysis, • DC theorems: Thevinen's Theorem Norton's theorem, Maximum Power Transfer Theorem,	9L
III	**Introduction to Electronics: Semiconductor Basics & Devices** • Difference between electrical and electronics • Role of electronics in computing, communication, healthcare, and automation	9L

	• Conductors, semiconductors, insulators • Intrinsic & extrinsic semiconductors (p-type, n-type – simple explanation) • Active Components: Diodes, transistors, LEDs, ICs • PN junction diode: forward/reverse bias, • Transistors: concept as switch & amplifier	
IV	**Digital Electronics & Logic** • Binary number systems & voltage levels (0s and 1s) • Logic gates: AND, OR, NOT, NAND, NOR (truth tables & symbols) • Simplification of Boolean functions using K- Mapp (Upto 4 variables) • Simple combinational logic (half adder, encoder/decoder – basic idea)	**9L**
V	**Electronics in the Modern World** • Motherboards, chipsets, RAM, processors (basic blocks) • Consumer electronics: smartphones, smart TVs, laptops • Computer hardware: power supply, microprocessor basics • IoT and Embedded Systems: microcontrollers (Arduino, Raspberry Pi), sensors & actuators • Applications in automation, wearables, renewable energy devices • Emerging technologies: AI chips, quantum computing (intro only)	**9L**

Text Books:

1. Robert L. Boylestand / Louis Nashelsky "Electronic Devices and Circuit Theory", Pearson Education.
2. R. Muthusubramanian, S. Salivahanan, "Basic Electrical and Electronics Engineering", Tata McGraw-Hill Education, Reprint 2012
3. George Kennedy, "Electronic Communication Systems", McGraw Publication

Reference Books:

1. David A. Bell, "Electronic Devices and Circuits", Oxford University Press.
2. Jacob Millman, C.C. Halkias, Stayabrata Jit, "Electronic Devices and Circuits", McGraw Hill
3. David A. Bell, Electronic Instrumentation and Measurements, Latest Edition, Oxford Uni Press India

If the course is available as **Generic Elective**, then the students of following departments may opt it: NO

Evaluation/Assessment Methodology	
Category	**Max. Marks**
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Physics of Class 12

Course Learning Outcomes:

CO-1	Apply the fundamental laws of electricity and circuit analysis to solve basic AC/DC circuit problems.	**L2 & L3**

CO-2	**Analyze** DC circuits using Kirchhoff's laws, network theorems, and circuit simplification methods.	**L3 &L4**
CO-3	**Explain** the working of semiconductor devices and their applications in switching and amplification.	**L1& L3**
CO-4	**Demonstrate** the use of digital electronics concepts including number systems, logic gates, and basic combinational circuits.	**L2 & L3**
CO-5	**Recognize** modern electronic systems, IoT devices, and emerging technologies in computing and automation.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech (CSE)**	**Year: I** **Semester: I/II**
Credits: 4 **Theory: 4** **Practical: 0**	**SUBJECT: FUNDAMENTALS OF MECHANICAL AND MECHATRONICS SYSTEMS**
Course Code: ENME-111/ENME-121	**TITLE: FUNDAMENTALS OF MECHANICAL AND MECHATRONICS SYSTEMS**

Course Objectives:

1. Introduce fundamental principles and theories in Mechanical Engineering.
2. Provide an overview of the historical development and current trends in Mechanical Engineering.
3. Familiarize students with basic engineering concepts such as forces, materials, structures, and systems relevant to both disciplines.
4. Develop problem-solving skills through practical applications and case studies in Mechanical Engineering contexts.
5. Cultivate an understanding of the interdisciplinary nature of Engineering and its impact on society and the environment.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**MATERIALS:** Classification of engineering material, Composition of Cast iron and Carbon steels, Iron Carbon diagram. Mechanical properties like strength, hardness, toughness, ductility, brittleness, malleability etc. of materials. Hooks law and modulus of elasticity, Hardness and Impact testing of materials, BHN etc.	9L
II	**Force Systems**: Basic concepts: Definitions, Basic assumptions, Scalar & Vector quantities, Classification of forces & Representation, Force as a Vector, Composition of forces, Parallelogram Law, Resolution, Principle of Transmissibility of forces **Coplanar Concurrent Force system and Coplanar:** Equilibrium of coplanar force system, Free body diagrams, Determination of reactions, Equilibrium of a body under three forces, Lami's theorem.	9L
III	**Introduction to mechanics of solid:** Normal and shear Stress, strain, Hookes' law, Poisson's ratio, elastic	9L

	constants and their relationship, stress-strain diagram for ductile and brittle materials, factor of safety. Basic Numerical problems. Types of beams under various loads.	
IV	**THERMODYNAMICS:** Thermodynamic system, properties, state, process, Zeroth, First and second law of thermodynamics, thermodynamic processes at constant pressure, volume, enthalpy & entropy. Steam Engineering: Classification and working of boilers, mountings and accessories of boilers, Efficiency.	**9L**
V	**Fundamental of Mechatronics:** Definition of Mechatronics, Sensors and Transducers: Definition, difference, classification, Actuators: Definition and Classification of Actuators Need and Scope, Programmable Logic Controller (PLC): Definition, PLC block diagram, Microcontroller: Comparison of Microprocessor and Microcontroller	**9L**

Text Books:
1. Nag P.K, Engineering Thermodynamics, TMH.
2. Agrawal C M, Basic Mechanical Engineering, Wiley Publication.

Reference Books:
1. Nag P.K, Engineering Thermodynamics, TMH.
2. Achuthan M, Engineering Thermodynamics, PHI. List of Suggestive
3. Ganesan, Internal Combustion Engines, TMH.
4. Textbook Of Mechatronics. R K Rajput

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand mechanical properties such as strength, hardness, toughness, ductility, brittleness, and malleability.	**L2 & L3**
CO-2	Understand the working principles of Lamis theorem	**L3 &L4**
CO-3	Understand steam engineering principles including boiler classification, mountings, accessories, and efficiency.	**L1& L3**
CO-4	Understand the concepts and purposes of various forces.	**L2 & L3**
CO-5	Understand about the basics of Mechatronics.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)												
CO-PO Mapping												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech (CSE)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Structured Programming and Problem Solving in C**
Course Code: ENCS-111	**Title: Structured Programming and Problem Solving in C**

Course Objectives:

1. To understand the basics of computers, programming languages, the history and structure of the C language, and its compilation and execution process.
2. To learn to define problems, analyze them, and create solutions using algorithms, flowcharts, and pseudo code.
3. To gain proficiency in data types, variables, constants, literals, operators, expressions, and input/output functions in C.
4. To apply conditional statements, switch-case statements, looping structures, and functions, including recursion and library functions, in C programs.
5. To Work with arrays, strings, pointers, structures, unions, file handling, preprocessor directives, and advanced data structures, and solve real-world problems through case studies and project-based learning.

Nature of Paper: VAC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total))

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION TO PROGRAMMING AND PROBLEM SOLVING:** **INTRODUCTION TO COMPUTERS AND PROGRAMMING:** Overview of computers and programming languages, History and evolution of C language, Basic structure of a C program, Compilation and execution process. **PROBLEM SOLVING TECHNIQUES:** Problem definition and analysis, Algorithms and flowcharts, Pseudocode **FUNDAMENTALS OF C:** Data types and variables, Constants and literals, Operators and expressions, Input and output functions.	**9L**
II	**CONTROL STRUCTURES AND FUNCTIONS:** **CONTROL STRUCTURES:** Conditional statements (if, if-else, nested if), Switch-case statements, looping structures (for, while, do-while), Break and continue statements, **FUNCTIONS:** Function declaration and definition, Function calling and parameter passing, Scope and lifetime of variables, Recursive functions,	**9L**

	Library functions.	
III	**ARRAYS, STRINGS, AND POINTERS:** **ARRAYS:** One-dimensional arrays, Two-dimensional arrays, Multidimensional arrays, Array operations and applications, **STRINGS:** String handling functions, String manipulation techniques. **POINTERS:** Introduction to pointers, Pointer arithmetic, Pointers and arrays, Pointers to functions, Dynamic memory allocation.	**9L**
IV	**STRUCTURES, UNIONS, AND FILE HANDLING:** **STRUCTURES AND UNIONS:** Defining and declaring structures, Accessing structure members, Array of structures, Nested structures, Unions and their applications. **FILE HANDLING:** File operations (opening, closing, reading and writing), File modes, Sequential and random access files, Error handling in file operations.	**9L**
V	**ADVANCED TOPICS AND CASE STUDIES:** **PREPROCESSOR DIRECTIVES:** Macros, File inclusion, Conditional compilation. **ADVANCED DATA STRUCTURES:** Introduction to linked lists, Stacks and queues (concepts and basic operations). **PROBLEM SOLVING CASE STUDIES:** Real-world problem solving using C, Case studies and project-based learning, Debugging and testing techniques, Best practices in programming.	**9L**

Text Books:

1. *Computer Programming with C, Special Edition-MRCET, Mc Graw Hill Publishers 2017,*
2. *Computer Science: A Structured Programming Approach Using C, B, A, Forouzan and R, F, Gilberg, Third Edition, Cengage Learning,*

Reference Books:

1. *The C Programming Language, B, W, Kernighan and Dennis M, Ritchie, PHI*
2. *Computer Programming, E, Balagurusamy, First Edition, TMH*
3. *C and Data structures – P, Padmanabham, Third Edition, B, S, Publications,*

If the course is available as **Generic Elective**, then the students of following departments may opt it: NO

Evaluation/Assessment Methodology

Category	Max, Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Students will demonstrate an understanding of the fundamentals of computers, and evolution of the C programming language, the basic structure of a C program,	**L2 & L3**

	and the compilation and execution processes.	
CO-2	Students will be able to define and analyze programming problems, develop algorithms, create flowcharts, and write pseudo code to design effective solutions.	**L1,L2& L3**
CO-3	Students will gain proficiency in fundamentals of C and will be able to implement basic input and output functions.	**L1,L2& L3**
CO-4	Students will be able to apply conditional statements, switch-case statements, and looping structures to control program flow, and will understand function declaration, definition, calling, parameter passing, scope, lifetime of variables, and recursion.	**L2,L3 & L4**
CO-5	Students will demonstrate the ability to work with arrays, strings, and pointers, define and utilize structures and unions, perform file operations, and understand advanced data structures like linked lists, stacks, and queues. They will also be able to solve real-world problems using C.	**L2,L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	3	1	2	2	1	0	0	0	1	2	3
CO-2	3	2	3	2	1	1	0	0	0	1	1	1
CO-3	3	2	2	2	1	0	0	0	0	0	1	3
CO-4	2	3	3	2	2	1	0	0	0	1	2	2
CO-5	1	3	2	3	2	1	0	0	0	0	1	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech (CSE)**	**Year: I** **Semester: I/II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Professional Communication and Digital fluency**
Course Code: ENAS-114/ ENAS-124	**Title: Professional Communication and Digital fluency**

Course Objectives:

1. To understand and apply basic principles of professional communication, including the communication process and overcoming barriers.
2. To enhance the essentials of technical writing for engineering, including reports, documentation, professional emails, and proposals.
3. To gain confidence in public speaking, create effective presentations, and learn to engage different audiences.
4. To develop skills for building rapport, effective teamwork, conflict resolution, and leadership communication.
5. To learn to effectively use digital communication tools, social media, and adapt to emerging trends in global engineering contexts.

Nature of Paper: AECC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Fundamentals of Communication:** Definition and importance, Communication process, Verbal and non-verbal communication, Barriers to communication, Formal and informal communication.	9L
II	**Professional Speaking and Presentation Skills:** Public speaking, Group discussion, Effective oral communication, Use of visual aids, Body language, Elevator pitch, Presentation planning and delivery.	9L
III	**Business and Technical Writing:** Email etiquette, Resume and cover letter writing, Report writing, Technical documentation, Memos, Minutes of meetings.	9L
IV	**Digital Literacy and Collaboration Tools:** Digital platforms for communication (Zoom,Teams, Slack), Cloud collaboration (Google Docs, OneDrive), Etiquette of digital communication, Netiquette, Cyber safety.	9L
V	**Professionalism and Work Ethics:** Workplace behavior, Teamwork, Leadership communication, Conflict resolution, Time management, Building online presence through LinkedIn and digital portfolios.	9L

Text Books and Reference Books:

1. *"Technical Communication: A Practical Approach" by William Sanborn Pfeiffer and Kaye E. Adkins*
2. *"The Essentials of Technical Communication" by Elizabeth Tebeaux and Sam Dragga*
3. *"Engineering Communication" by Charles W. Knisely and Karin I. Knisely*
4. *"Communicating in Groups: Applications and Skills" by Katherine Adams, Gloria Galanes, and Brandi R. Fritz*
5. *"Digital Communications: Fundamentals and Applications" by Bernard Sklar*

If the course is available as **Generic Elective**, then the students of following departments may opt it: NO

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations/Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: English of Class 12

Course Learning Outcomes:

CO-1	Demonstrate effective communication skills, including verbal, non-verbal, and written, in professional engineering contexts.	**L2 & L3**
CO-2	Develop clear, concise, and coherent technical documents, including reports, project documentation, and professional emails.	**L3 &L4**
CO-3	Deliver engaging and informative oral presentations tailored to diverse audiences, utilizing effective visual aids and presentation techniques.	**L1& L3**
CO-4	Exhibit strong interpersonal and teamwork skills, including active listening, conflict resolution, and leadership communication.	**L2 & L3**
CO-5	Utilize digital communication tools and social media platforms to enhance professional networking and collaboration, adapting to emerging communication trends and global engineering contexts.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech (CSE)**	**Year: I** **Semester: I/II**
Credits: 5 **Theory: 4** **Practical: 1**	**SUBJECT: ENVIRONMENT, ECOLOGY AND SUSTAINIBILITY**
Course Code: ENHU-112/ ENHU-122	**TITLE: ENVIRONMENT, ECOLOGY AND SUSTAINIBILITY**

Course Objectives:

1. To introduce students to the interrelationship between humans and the environment, tracing historical, cultural, and ethical dimensions of sustainability.
2. To equip students with knowledge about natural resources, biodiversity, ecosystems, and their conservation strategies.
3. To raise awareness of major environmental issues local to global—such as pollution, climate change, land degradation, and disaster risk.
4. To familiarize students with environmental laws, policies, and international treaties related to environmental governance and sustainable development.
5. To encourage experiential learning through field visits, case studies, and hands-on campus environmental management activities.

Nature of Paper: AECC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total))
50% Marks / 1 Credits

L : 3	T : 1	P : 3	C : 4+1

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Humans and the Environment:** The man-environment interaction: Humans as hunter-gatherers; Mastery of fire; Origin of agriculture; Emergence of city-states; Great ancient civilizations and the environment, Indic Knowledge and Culture of sustainability; Middle Ages and Renaissance; Industrial revolution and its impact on the environment; Population growth and natural resource exploitation; Global environmental change. **Environmental Ethics and emergence of environmental ism**:Anthropocentric and eco-centric perspectives (Major thinkers); The Club of Rome- Limits to Growth; UN Conference on Human Environment 1972; World Commission on Environment and Development and the concept of sustainable development; Rio Summit and subsequent international efforts.	**9L**
II	**Natural Resources and Sustainable Development**: Overview of natural resources: Definition of resource; Classification of natural resources- biotic and abiotic, renewable and non-renewable.	**9L**

	Biotic resources: Major type of biotic resources- forests, grasslands, wetlands, wildlife and aquatic (fresh water and marine); Microbes as a resource; Status and challenges. **Water resources**: Types of water resources-fresh water and marine resources; Availability and use of water resources; Environmental impact of over-exploitation, issues and challenges; Water scarcity and stress; Conflicts over water. **Soil and mineral resources**: Important minerals; Mineral exploitation; Environmental problems due to extraction of minerals and use; Soil as a resource and its degradation. **Energy resources**: Sources of energy and their classification, renewable and non-renewable sources of energy; Conventional energy sources- coal, oil, natural gas, nuclear energy; Non-conventional energy sources- solar, wind, tidal, hydro, wave, ocean thermal, geothermal, biomass, hydrogen and fuel cells; Implications of energy use on the environment. **Introduction to sustainable development**: Sustainable Development Goals (SDGs) - targets and indicators, challenges and strategies for SDGs.	
III	**Environmental Issues: Local, Regional and Global:** **Environmental issues and scales**: Concepts of micro-, meso-, synoptic and planetary scales; Temporal and spatial extents of local, regional, and global phenomena. **Pollution**: Impact of sectoral processes on Environment; Types of Pollution- air, noise, water, soil, thermal, radioactive; municipal solid waste, hazardous waste; transboundary air pollution; acid rain; smog. Land use and Land cover change: land degradation, deforestation, desertification, urbanization. Biodiversity loss: past and current trends, impact. **Global change**: Ozone layer depletion; Climate change. Disasters – Natural and Man-made	**9L**
IV	**Conservation of Biodiversity and Ecosystems:** Biodiversity and its distribution: Biodiversity as a natural resource; Levels and types of biodiversity; Biodiversity in India and the world; Biodiversity hotspots; Species and ecosystem threat categories. **Ecosystems and ecosystem services**: Major ecosystem types in India and their basic characteristics- forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services- classification and their significance. Threats to biodiversity and ecosystems: Land use and land cover change; Commercial exploitation of species; Invasive species; Fire, disasters and climate change. **Major conservation policies**: in-situ and ex-situ conservation approaches; Major protected areas; National and International Instruments for biodiversity conservation; the role of traditional knowledge, community-based conservation; Gender and conservation.	**9L**
V	**Environmental Pollution and Health:** Understanding pollution: Production processes and generation of wastes; Assimilative capacity of the environment; Definition of pollution; Point sources and non-point sources of pollution. **Air pollution:** Sources of air pollution; Primary and secondary pollutants; Criteria pollutants- carbon monoxide, lead, nitrogen oxides, ground-level	**9L**

	ozone, particulate matter and sulphur dioxide; Other important air pollutants- Volatile Organic compounds (VOCs), Peroxyacetyl Nitrate (PAN), Polycyclic aromatic hydrocarbons (PAHs) and Persistent organic pollutants (POPs); Indoor air pollution; Adverse health impacts of air pollutants; National Ambient Air Quality Standards. Water pollution: Sources of water pollution; River, lake and marine pollution, groundwater pollution; water quality Water quality parameters and standards; adverse health impacts of water pollution on human and aquatic life. **Soil pollution and solid waste:** Soil pollutants and their sources; Solid and hazardous waste; Impact on human health. **Noise pollution:** Definition of noise; Unit of measurement of noise pollution; Sources of noise pollution; Noise standards; adverse impacts of noise on human health. Thermal and Radioactive pollution: Sources and impact on human health and ecosystems.	
VI	**Climate Change: Impacts, Adaptation and Mitigation:** Understanding climate change: Natural variations in climate; Structure of atmosphere; Anthropogenic climate change from greenhouse gas emissions– past, present and future; Projections of global climate change with special reference to temperature, rainfall, climate variability and extreme events; Importance of 1.5 °C and 2.0 °C limits to global warming; Climate change projections for the Indian sub-continent. **Impacts, vulnerability and adaptation to climate change:** Observed impacts of climate change on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests and natural ecosystems; Impacts on animal species, agriculture, health, urban infrastructure; the concept of vulnerability and its assessment; Adaptation vs. resilience; Climate-resilient development; Indigenous knowledge for adaptation to climate change. **Mitigation of climate change**: Synergies between adaptation and mitigation measures; Green House Gas (GHG) reduction vs. sink enhancement; Concept of carbon intensity, energy intensity and carbon neutrality; National and international policy instruments for mitigation, decarbonizing pathways and net zero targets for the future; Energy efficiency measures; Renewable energy sources; Carbon capture and storage, National climate action plan and Intended Nationally Determined Contributions (INDCs); Climate justice.	**9L**
VII	**Environmental Management:** Introduction to environmental laws and regulation: Constitutional provisions- Article 48A, Article 51A (g) and other derived environmental rights; Introduction to environmental legislations on the forest, wildlife and pollution control. Environmental management system: ISO 14001 Concept of Circular Economy, Life cycle analysis; Cost-benefit analysis Environmental audit and impact assessment; Environmental risk assessment Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability; Ecolabeling/Ecomark scheme	**9L**
VIII	**Environmental Treaties and Legislation**: An overview of instruments of	**9L**

	international cooperation; bilateral and multilateral agreements; conventions and protocols; adoption, signature, ratification and entry into force; binding and non- binding measures; Conference of the Parties (COP) **Major International Environmental Agreements**: Convention on Biological Diversity (CBD); Cartagena Protocol on Biosafety; Nagoya Protocol on Access and Benefit-sharing; **Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES);** Ramsar Convention on Wetlands of International Importance; United Nations Convention to Combat Desertification (UNCCD); Vienna Convention for the Protection of the Ozone Layer; Montreal Protocol on Substances that Deplete the Ozone Layer and the Kigali Amendment; Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal; Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade; Stockholm Convention on Persistent Organic Pollutants; Minamata Convention on Mercury; United Nations Framework Convention on Climate Change (UNFCCC); Kyoto Protocol; Paris Agreement; India's status as a party to major conventions **Major Indian Environmental Legislations**: The Wild Life (Protection) Act, 1972; The Water (Prevention and Control of Pollution) Act, 1974; The Forest (Conservation) Act, 1980; The Air (Prevention and Control of Pollution) Act, 1981; The Environment (Protection) Act, 1986; The Biological Diversity Act, 2002; The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006; Noise Pollution (Regulation and Control) Rules, 2000; Industry-specific environmental standards; Waste management rules; Ramsar sites; Biosphere reserves; Protected Areas; Ecologically Sensitive Areas; Coastal Regulation Zone; Status phase-out of production and consumption of Ozone Depleting Substances by India; National Green Tribunal; Some landmark Supreme Court judgements **Major International organizations and initiatives**: United Nations Environment Programme (UNEP), International Union for Conservation of Nature (IUCN), World Commission on Environment and Development (WCED), United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Panel on Climate Change (IPCC), and Man and the Biosphere (MAB) programme.	
IX	**Case Studies and Field Work**: The students are expected to be engaged in some of the following or similar identified activities: 1. Discussion on one national and one international case study related to the environment and sustainable development. 2. Field visits to identify local/regional environmental issues, make observations including data collection and prepa re a brief report. 3. Participation in plantation drive and nature camps. 4. Documentation of campus biodiversity. Campus environmental management activities such as solid waste disposal, water Management and sanitation, and sewage treatment.	**9L**
Reference Books: Reference Books: 1. Fisher, Michael H. (2018) An Environmental History of India- From Earliest Times to the Twenty-		

First Century, Cambridge University Press.
2. Hedrick, Daniel R. (2020) Humans versus Nature- A Global Environmental History, Oxford University Press.
3. Hughes, J. Donald (2009) An Environmental History of the World- Humankind's ChangingRole in the Community of Life, 2nd Edition. Routledge.
4. Perman, R., Ma, Y., McGillivray, J., and Common, M. (2003) Natural Resource and Environmental Economics. Pearson Education.
5. Simmons, I. G. (2008). Global Environmental History: 10,000 BC to AD 2000. Edinburgh University Press
6. Chiras, D. D and Reganold, J. P. (2010). Natural Resource Conservation: Management for a Sustainable Future.10th edition, Upper Saddle River, N. J. Benjamin/Cummins/Pearson.
7. John W. Twidell and Anthony D. (2015). Renewable Energy Sources, 3rd Edition, Weir Publisher (ELBS)
8. William P.Cunningham and Mary A. (2015) Cunningham Environmental Science: A Global Concern, Publisher (Mc-Graw Hill, USA)
9. Gilbert M. Masters and W. P. (2008). An Introduction to Environmental Engineering and Science, Ela Publisher (Pearson)
10. Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications https://sdgs.un.org/goals
11. Harper, Charles L. (2017) Environment and Society, Human Perspectives on Environmental Issues 6th Edition. Routledge.
12. Harris, Frances (2012) Global Environmental Issues, 2nd Edition. Wiley- Blackwell.
13. William P. Cunningham and Mary A. (2015). Cunningham Environmental Science: A global concern, Publisher (Mc-Graw Hill, USA)
14. Manahan, S.E. (2022). Environmental Chemistry (11th ed.). CRC Press. https://doi. org/10.1201/9781003096238
15. Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press.
16. Bawa, K.S., Oomen, M.A. and Primack, R. (2011) Conservation Biology: A Primer for South Asia. Universities Press.
17. Sinha, N. (2020) Wild and Wilful. Harper Collins, India.
18. Varghese, Anita, Oommen, Meera Anna, Paul, Mridula Mary, Nath, Snehlata (Editors) (2022) Conservation through Sustainable Use: Lessons from India. Routledge.
19. Bhagwat, Shonil (Editor) (2018) Conservation and Development in India: Reimagining Wilderness, Earthscan Conservation and Development, Routledge.
20. Krishnamurthy, K.V. (2003) Textbook of Biodiversity, Science Publishers, Plymouth, UK
21. Jackson, A. R., & Jackson, J. M. (2000). Environmental Science: The Natural Environment and Human Impact. Pearson Education.
22. Masters, G. M., & Ela, W. P. (2008). *Introduction to environmental engineering and science* (No. 60457). Englewood Cliffs, NJ: Prentice Hall.
23. Miller, G. T., & Spoolman, S. (2015) Environmental Science. Cengage Learning.
24. Central Pollution Control Board Web page for various pollution standards. https://cpcb.nic.in/ standards/
25. Ahluwalia, V. K. (2015). *Environmental Pollution, and Health*. The Energy and Resources Institute (TERI).
26. Pittock, Barrie (2009) Climate Change: The Science, Impacts and Solutions. 2nd Edition. Routledge.
27. www.ipcc.org; https://www.ipcc.ch/report/sixth-assessment-report-cycle/.

28. Adenle A., Azadi H., Arbiol J. (2015). Global assessment of technological innovation for climate change adaptation and mitigation in developing world, Journal of Environmental Management, 161 (15): 261-275.
29. Barnett, J. & S. O'Neill (2010). Maladaptation. Global Environmental Change—Human and Policy Dimensions 20: 211–213.
30. Berrang-Ford, L., J.D. Ford & J. Paterson (2011). Are we adapting to climate change? Global Environmental Change—Human and Policy Dimensions 21: 25-33.
31. Jørgensen, Sven Marques, Erik João Carlos and Nielsen, Søren Nors (2016) Integrated Environmental Management, A transdisciplinary Approach. CRC Press.
32. Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.
33. Barrow, C. J. (1999). Environmental management: Principles and practice. Routledge.
34. Tiefenbacher, J (ed.) (2022), Environmental Management - Pollution, Habitat, Ecology, and Sustainability, Intech Open, London. 10.5772/
35. Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.
36. UNEP (2007) Multilateral Environmental Agreement Negotiator's Handbook, University of Joensuu, ISBN 978-952-458-992-5
37. Ministry of Environment, Forest and Climate Change (2019) A Handbook on International Environment Conventions & Programmes. https://moef.gov.in/wp- content/uploads/2020/02/ convention-V-16-CURVE-web.pdf
38. Kanchi Kohli and Manju Menon (2021) Development of Environment Laws in India, Cambridge University Press.
39. India Code – Digital repository of all Central and State Acts: https://www.indiacode.nic.in/Bohra, Saroj, Judicial Intervention and Evolution of Environmental Principles and Doctrines (January 7, 2019). Available at SSRN: https://ssrn.com/abstract=3311406 or http://dx.doi. org/10.2139/ssrn.3311406

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Course Learning Outcomes:

CO1	Explain the evolution of human-environment interaction, environmental ethics, and sustainability principles.	L2
CO2	Classify natural resources and evaluate their usage, challenges, and conservation strategies.	L3
CO3	Analyze local, regional, and global environmental issues, including pollution, biodiversity loss, and land use change.	L4
CO4	Interpret the causes, consequences, and mitigation strategies of climate change and	L3

	global environmental change.	
CO5	Describe key environmental policies, laws, and treaties at national and international levels.	L2

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO1	2	1	1	1	1	2	3	2	1	2	0	2
CO2	2	2	2	2	1	2	3	2	0	1	0	3
CO3	1	2	2	2	1	3	3	2	1	2	0	3
CO4	2	2	2	2	2	3	3	2	1	2	0	3
CO5	2	1	1	1	1	3	3	3	0	2	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech (CSE)**	**Year: I** **Semester: I/II**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: MODERN PHYSICS IN ENGINEERING LAB**
Course Code: ENAS-112P/ ENAS-122P	**Title: MODERN PHYSICS IN ENGINEERING LAB**

Course Objectives:
1. To understand the concept of wave length by the interference
2. To understand the concept of wave length by the diffraction.
3. To understand the concept of viscosity of liquid and flow of liquid
4. To understand the energy band gap in the semiconductors
5. To understand the concept of polarization

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	To determine the wavelength of Sodium light by Newton's rings
Practical-2.	To determine the wavelength of prominent lines of mercury by plane diffraction grating
Practical-3.	To determine the focus length combination of two lenses separated by distance and verify the formula for the focal length of combination of lenses
Practical-4.	To determine the wave length of sodium light with the help of Fresnel's bi-prism
Practical-5.	To determine the coefficient of viscosity of a given liquid
Practical-6.	To verify Stefan's law
Practical-7.	Calibration of a volt meter with potentiometer
Practical-8.	To determine the resistance per unit length and specific resistance of a given resistance using Carey Foster 's Bridge
Practical-9.	To determine the energy bend gap of a given semiconductor material
Practical-10.	To determine the Specific Rotation of the Cane sugar solution with the help of Polarimeter

Reference/Text Books:
1. *Practical Physics- K. K. Dey & B. N. Dutta (Kalyani Publishers New Delhi)*
2. *Engineering Physics- Practical- Katiyar & Pandey (Wiley India)*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce (External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	To determine the wavelength of sodium light by Newton's ring experiment	**L3**
CO-2	To determine the wavelength of sodium light with the help of Fresnel's bi-prism	**L3**
CO-3	To determine the viscosity of liquid.	**L3**
CO-4	To determine the emission of energy with respect the temperature and verify Stefan's law.	**L3 & L4**
CO-5	To determine the calibration of potential and draw the curve.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	2	0	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	2	2	1	0	0	0	0	0	0	2	2
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech (CSE)**	**Year: I** **Semester: I/II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: Engineering Chemistry Lab**
Course Code: ENAS-113P/ ENAS-123P	**Title: Engineering Chemistry Lab**

Course Objectives:
1. Student will be able to Estimate different impurities present in water sample.
2. Student will be able to Determine molecular properties such as surface tension, viscosity, pH, conductance and concentration of solution.
3. Student will be able to Identify iron concentration and percentage of available chlorine in supplied sample using titration methods

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	To determine total alkalinity in the given water sample.
Practical-2.	To determine the temporary and permanent hardness in water sample using EDTA as standard solution.
Practical-3.	To determine the available chlorine in bleaching powder solution.
Practical-4.	To determine the chloride content in the given water sample by Mohr's method.
Practical-5.	To determine the pH of the given solution using pH meter and pH-metric titration.
Practical-6.	To determine the Equivalent weight of Iron by the chemical displacement method.
Practical-7.	To determine the Viscosity of an addition polymer like polyester by Viscometer.
Practical-8.	To find chemical oxygen demand of waste water sample by potassium dichromate
Practical-9.	To determine the iron content in the given sample using external indicator
Practical-10.	To determine the strength of given HCL solution by titrating against N/10 Standard Sodium hydroxide solution

Reference/Text Books:
1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal	10

2) Presentation/Seminar/Viva-Voce(Internal)	Assessment	05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Estimate different impurities present in water sample.	**L4**
CO-2	Determine molecular properties such as surface tension, viscosity, pH, conductance and concentration of solution	**L3**
CO-3	Identify iron concentration and percentage of available chlorine in supplied sample using titration methods.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	0	2	1	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	3	3	1	0	0	0	0	0	0	2	1
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech (CSE)**	**Year: I** **Semester: I & II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: PROGRAMMING WITH C LAB: HANDS ON LOGIC BUILDING**
Course Code: ENCS-111P	**Title: PROGRAMMING WITH C LAB: HANDS ON LOGIC BUILDING**

Course Objectives:

1. To develop proficiency in implementing fundamental programming constructs such as loops, conditionals, functions, and arrays in C language through hands-on lab exercises.
2. To Gain practical experience in implementing and using data structures like arrays, linked lists, stacks, and queues to solve programming problems during lab sessions.
3. To Enhance problem-solving skills by applying algorithms learned in theory to practical programming tasks.
4. To engage in project-based learning activities where students work in teams to tackle larger programming projects.
5. To acquire skills in debugging and error handling techniques by identifying and resolving common programming errors encountered during lab exercises, ensuring robust and error-free code.

Nature of Paper: VAC (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Develop a program that performs basic arithmetic operations (addition, subtraction, multiplication, division) based on user input.
Practical-2.	Create a program to convert temperatures between Celsius, Fahrenheit, and Kelvin.
Practical-3.	Build a basic ATM simulation that allows users to check balance, deposit, and withdraw money.
Practical-4.	Develop a program to simulate a simple voting system with options and tallying votes.
Practical-5.	Create a program to calculate student grades based on user input of marks.
Practical-6.	Write a program that identifies whether a number is odd or even.
Practical-7.	Develop a program to check if a given year is a leap year.
Practical-8.	Create a program to solve quadratic equations.
Practical-9.	Implement a menu-driven program that performs different tasks like calculating area, volume, etc., based on user choice.
Practical-10.	Develop a recursive function to compute the factorial of a number.

Practical-11.	Develop a program to store and manipulate student marks using arrays. Calculate average, highest, and lowest marks.
Practical-12.	Implement a program to perform multiplication of two matrices.
Practical-13.	Create a function to reverse a string without using library functions.
Practical-14.	Write a program to dynamically allocate memory for an array and perform operations on it (e.g., finding the maximum element).
Practical-15.	Implement linear and binary search algorithms to find an element in an array
Practical-16.	Develop a program to check if a given string is a palindrome.
Practical-17.	Create a function that swaps two variables using pointers.
Practical-18.	Write a program to count the frequency of each character in a string.
Practical-19.	Develop a program to dynamically resize an array as elements are added or removed.
Practical-20.	Implement a function to concatenate two strings without using library functions.
Practical-21.	Create a program to manage employee records using structures.
Practical-22.	Implement a program to store and retrieve student details using file handling.
Practical-23.	Write a program to copy contents from one file to another.
Practical-24.	Create a payroll system that calculates and displays employee salaries, storing the data in files.
Practical-25.	Implement an inventory management system to track products using structures and file handling.
Practical-26.	Develop a program to manage patient records using structures and files.
Practical-27.	Create a program to demonstrate file error handling techniques.
Practical-28.	Write a program to generate student grade reports and save them in a file.
Practical-29.	Implement a singly linked list with operations like insertion, deletion, and traversal.
Practical-30.	Create a program to implement stack operations using arrays and linked lists.
Practical-31.	Develop a program to simulate a queue using arrays and linked lists.
Practical-32.	Write a program to count the number of words in a text file.
Practical-33.	Implement a program using macros for basic arithmetic calculations.
Practical-34.	Develop a program to recursively list all files in a directory (if operating system access is allowed).
Practical-35.	Implement a basic Sudoku solver using backtracking and recursion.
Practical-36.	Develop a comprehensive project simulating bank transactions including account creation, deposit, withdrawal, and balance inquiry, integrating structures, file handling, and dynamic memory allocation.

Text Books:

1. *Computer Programming with C, Special Edition-MRCET, Mc Graw Hill Publishers 2017,*
2. *Computer Science: A Structured Programming Approach Using C, B, A, Forouzan and R, F, Gilberg, Third Edition, Cengage Learning,*

Reference Books:

1. *The C Programming Language, B, W, Kernighan and Dennis M, Ritchie, PHI*

2. *Computer Programming, E, Balagurusamy, First Edition, TMH*
3. *C and Data structures – P, Padmanabham, Third Edition, B, S, Publications,*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Able to develop programs that perform fundamental arithmetic operations	**L2 & L3**
CO-2	Ale to use arrays, pointers, and structures by creating programs for matrix multiplication, student mark storage, employee records management, and dynamically resizing arrays	**L3 &L4**
CO-3	Able to implement recursive functions, linear and binary search algorithms	**L1& L3**
CO-4	will learn to manage data using file handling techniques, including storing and retrieving student details, copying file contents, generating grade reports, and handling file errors, essential for real-world applications	**L2 & L3**
CO-5	will apply their theoretical knowledge to practical, real-life scenarios, integrating multiple programming concepts seamlessly	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	1	0	0	0	1	2	3
CO-2	3	3	3	2	1	1	0	0	0	1	1	3
CO-3	3	3	3	3	1	0	0	0	0	0	1	3
CO-4	3	3	3	2	2	1	0	0	0	1	2	3
CO-5	3	3	3	3	2	1	0	0	0	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech (CSE)**	**Year: I** **Semester: I/II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: PROFESSIONAL COMMUNICATION LAB**
Course Code: ENAS-114P/ ENAS-124P	**Title: PROFESSIONAL COMMUNICATION LAB**

Course Objectives:

1. To enhance students' ability to communicate effectively in social and professional settings
2. To focus on the correct pronunciation and intonation patterns of English to ensure clear and understandable speech
3. To provide a solid foundation in English grammar and expand vocabulary for more accurate and expressive language use
4. To develop active listening skills and improve comprehension abilities through focused practice and exercises
5. To equip students with essential soft skills such as interview handling, email etiquette, and presentation skills to succeed in professional environments.

Nature of Paper: AECC (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0	T: 0	P: 2	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title(English-Wordsworth-Language Lab)
Module-1.	**Communication Skills –** 1. Social Meeting People & Asking Questions 2. Making Friends 3. Dos & Don'ts 4. What do you do?
Module-2.	**English Concepts –** 1. Tenses 2. Parts of Speech 3. Figures of Speech 4. Direct & Indirect Speech
Module-3.	**Pronunciation –** 1. Phonetics & Intonations 2. Vowels, Consonants, Nouns
Module-4.	**Communication Skills –** 1. Listening Skills 2. Speaking Skills 3. Reading Skills 4. Writing Skills

Module-5.	**Advance Learning & Soft Skills –** 1. Effective Communication 2. Interview Handling Skills 3. Email Etiquette 4. Presentation Skills 5. Listening Comprehension

Text Books/Reference Books:

1. *Daniel Jones: English Pronouncing Dictionary*
2. *R.K. Bansal: Phonetics in English*
3. *Sethi and Dhamija: A Course in English Phonetics*
4. *S.D. Sharma: A Text-Book of Professional Communication & ESP*
5. *S.D. Sharma: Manual on Communication Lab English*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Students will demonstrate improved ability to meet and engage with people, make friends, and handle social interactions confidently and appropriately	**L2 & L3**
CO-2	Students will exhibit correct pronunciation, intonation, and the ability to articulate vowels, consonants, and nouns clearly	**L3 &L4**
CO-3	Students will show proficiency in using tenses, parts of speech, and figures of speech in both written and spoken English	**L1& L3**
CO-4	Students will display heightened listening skills and the ability to comprehend and respond accurately to spoken and written English	**L1 & L4**
CO-5	Students will be able to effectively manage interviews, compose professional emails, and deliver impactful presentations, showcasing their preparedness for professional scenarios	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	1	0	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	2	2	1	0	0	0	0	1	2
CO-3	0	2	2	2	1	0	0	0	0	0	1	2
CO-4	1	3	2	2	2	0	0	0	0	0	1	1
CO-5	1	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech (CSE)**	**Year: I** **Semester: I/II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: ELECTRONICS IN THE MODERN WORLD LAB**
Course Code: ENEE-111P/ ENEE-121P	**Title: ELECTRONICS IN THE MODERN WORLD LAB**

Course Objectives:
1. To analyze a given network by applying various electrical laws.
2. To analyze a given network by applying various electrical network theorems
3. To know the response of electrical circuits for different excitations
4. To calculate, measure and know the relation between basic electrical parameters
5. To calculate, measure and know the relation between basic electronics parameters

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & (50% of External Assessment)

L: 0	**T:** 0	**P:** 2	**C:** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Verification of Ohms Law.
Practical-2.	Verification of KCL and KVL for DC Circuits.
Practical-3.	Verification of Superposition Theorem.
Practical-4.	Verification of Thevenin`s Theorem
Practical-5.	Verification of Norton`s Theorem
Practical-6.	Verification of Maximum Power Transfer Theorem
Practical-7.	Calculations and Verification of Impedance and Current of RL, RC and RLC series Circuits.
Practical-8.	Measurement of Voltage, Current and Real Power in primary and Secondary AC Circuits
Practical-9.	The identification & Testing of Electronic component.
Practical-10.	Diode Characteristics (Si) a) Forward Bias b) Reverse Bias
Practical-11.	Study and analysis of half Wave rectifier with & without filter.
Practical-12.	Study and analysis of full Wave rectifier with & without filter.
Practical-13.	Transistor CE Characteristics (I/P & O/P)

Text Books:

1. Robert L. Boylestand / Louis Nashelsky "Electronic Devices and Circuit Theory", Pearson Education.
2. R. Muthusubramanian, S. Salivahanan, "Basic Electrical and Electronics Engineering", Tata McGraw-Hill Education, Reprint 2012
3. George Kennedy, "Electronic Communication Systems", McGraw Publication

Reference Books:

1. David A. Bell, "Electronic Devices and Circuits", Oxford University Press.
2. Jacob Millman, C.C. Halkias, StayabrataJit, "Electronic Devices and Circuits", McGraw Hill
4. David A. Bell, Electronic Instrumentation and Measurements, Latest Edition, Oxford Uni Press India

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3)External Practical Assessment	External Assessment	20
4)Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Create basic electrical connections for domestic applications	**L2 & L3**
CO-2	Measure the various electrical parameters in the DC circuit	**L3 & L4**
CO-3	Measure the various electrical parameters in the AC circuit	**L1 & L3**
CO-4	To study basic electronic components.	**L2 & L3**
CO-5	To get the practical expose of the Transistors applications.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	2	2	1	0	0	0	0	1	2
CO-3	3	3	2	2	1	0	0	0	0	0	1	2
CO-4	3	3	2	2	2	0	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech (CSE)**	**Year: I** **Semester: II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: Introduction to CNC and 3-D Printer Lab**
Course Code: ENME-123P	**Title: Introduction to CNC and 3-D Printer Lab**

Course Objectives:

1. Understanding CNC and 3D Printing Technologies
2. Gain hands-on experience with CNC machines and 3D printers, including setup, operation, maintenance, and troubleshooting.
3. Identify and select appropriate materials for CNC machining and 3D printing based on their properties and application requirements.
4. Apply quality control methods and standards to ensure the production of high-quality parts.\
5. Explore the diverse industry applications of CNC machining and 3D printing, including automotive, aerospace, healthcare, and consumer products

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Marks (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Overview of CNC machine components and functions.
Practical-2.	Introduction to G-code and M-code.
Practical-3.	Writing simple CNC programs for basic shapes (e.g., square, circle).
Practical-4.	Loading and securing the workpiece along with tool selection and tool path setup.
Practical-5.	Programming and executing 2D milling operations to Creating a flat surface, slot, and pocket milling.
Practical-6.	Overview of CNC lathe operations along with programming and executing turning operations (e.g., facing, turning, threading).
Practical-7.	Introduction to CNC simulation software and Simulating CNC programs to verify tool paths and operations.
Practical-8.	Overview of 3D printing technology and applications along with Safety procedures and lab protocols.
Practical-9.	Understanding the parts of a 3D printer. With Basics of printer maintenance and troubleshooting.
Practical-10.	Introduction to CAD software (e.g., Tinkercad, Fusion 360).
Practical-11.	Designing simple 3D models for printing.

Practical-12.	Introduction to slicing software (e.g., Cura, Prusa Slicer).
Practical-13.	Developing a small project that incorporates both CNC and 3D printing techniques

Reference/Text Books:

1. *"CNC Programming" S K Sinha*
2. *" Functional Design for 3D" by Mr Clifford T Smyth*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Understanding CNC and 3D Printing Technologies	**L2 & L3**
CO-2	Gain hands-on experience with CNC machines and 3D printers, including setup, operation, maintenance, and troubleshooting.	**L3 &L4**
CO-3	Understand the properties and selection criteria of various materials used in CNC machining and 3D printing	**L1 & L3**
CO-4	Develop skills in designing 3D models suitable for CNC machining and 3D printing, including considerations for manufacturability and printability.	**L2 & L3**
CO-5	Understand quality control methods and standards for parts produced by CNC machining and 3D printing.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech (CSE)**	**Year: I** **Semester: I/II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: Mechanical Workshop Lab**
Course Code: ENME-112P/ENME-122P	**Title: Mechanical Workshop Lab**

Course Objectives:

1. To understand the importance of tools used in workshop.
2. To prepare various joints used in workshop.
3. To identify & apply the most appropriate tools for various applications.
4. To perform the various types of black smithy and sheet metal shop operations.
5. Introduce students to the fundamentals of Computer Numerical Control (CNC) machines, including their components, operation principles, and applications in modern manufacturing.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 3	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Module-1	**Carpentry Shop:** **Practical-1:** To prepare half-lap corner joint. **Practical-2:** To prepare mortise & Tenon joint. **Practical-3:** To prepare a cylindrical pattern on woodworking lathe
Module-2	**Fitting Bench Working Shop:** **Practical-1:** To prepare a V-joint fitting **Practical-2:** To prepare a U-joint fitting **Practical-3:** To make a perfect square job
Module-3	**Black Smithy Shop:** **Practical-1:** To prepare a square rod from given circular rod. **Practical-2:** To prepare a square S- shape from given circular rod. **Practical-3:** To prepare a nail from given circular rod.
Module-4	**Welding Shop:** **Practical-1:** To prepare a butt welded joints using arc welding machine. **Practical-2:** To prepare a "T" welded joints using MIG welding machine. **Practical-3:** To prepare a Lap welded joint using resistance spot welding machine.
Module-5	**Sheet-metal Shop:** **Practical-1:** To make round duct of GI sheet using 'soldering' process. **Practical-2:** To prepare a tray of GI by fabrication

Module-6	**Machine Shop:** **Practical-1:** To prepare a bolt on the lathe machine as per given. Diagram. **Practical-2:** To prepare a slot on the horizontal milling machine as per given diagram.
Module-7	**Foundry Shop:** **Practical-1:** To prepare core as per given size. **Practical-2:** To prepare a mould for given casting.
Module-8	**CNC Shop:** **Practical-1:** Learn about the components of a CNC machine and their functions. **Practical-2:** Learn how to set up a work piece in the CNC machine (fixturing, tooling, work holding). **Practical-3:** Understand the process of loading tools into the machine and tool length offsets. **Practical-4:** Mount the cutting tool on the tool post and set its position relative to the work piece. **Practical-5:** To prepare a turning job on a CNC lathe machine according to a given diagram.

Reference/Text Books:

1. *A Course In Workshop Technology (Manufacturing Processes Vol. 1, B.S. Raghuwanshi, Publisher, Dhanpat Rai & Co.*
2. *Manufacturing Processes, Kumar & Gupta, Prentice Hall India.*
3. *Production Technology, Jain, Khanna Publications.*
4. *CNC Machining for Beginners by Paul Smith*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce (External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Understand the tools used in workshop & their applications.	**L2 & L3**
CO-2	Prepare various joints used in carpentry, fitting and welding shop.	**L3 &L4**
CO-3	Identify & apply the most appropriate tools for various manufacturing operations like turning, facing and threading.	**L1& L3**
CO-4	Perform the various types of black smithy and sheet metal shop operations.	**L2 & L3**
CO-5	Students will demonstrate proficiency in setting up CNC machines, loading programs, and executing machining operations to achieve specified dimensions and tolerances.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	0	3	0	0	0	1	0	0	2	1
CO-2	0	3	3	3	0	1	3	1	1	1	2	1
CO-3	0	2	2	2	3	2	0	0	0	2	2	2
CO-4	0	2	2	1	2	1	0	0	0	0	3	1
CO-5	1	2	1	1	1	0	0	0	0	0	0	0

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech (CSE)**	**Year: I** **Semester: I/II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: Engineering Graphics & Design Lab**
Course Code: ENME-113P/ ENME-123P	**Title: Engineering Graphics & Design Lab**

Course Objectives:

1. To study the standard and rules to be trailed by engineers for making precise drawings.
2. To understand the fundamental dimensioning practices that must be continued in the arrangement of drawings.
3. To draw the various types of projection of lines, planes and solids.
4. To apply the CAD for design.
5. To create the engineering models.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 1 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 1

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Introduction to Engineering Drawing, Orthographic Projections: Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain and Diagonal Scales. Principles of Orthographic Projections – Conventions – Projections of Points and Lines inclined to both planes; Projections of planes inclined Planes – Auxiliary Planes.
Practical-2.	Projections and Sections of Regular Solids: Sections in lined to both the Planes – Auxiliary Views; Simple annotation, dimensioning and scale. Floor plans they include: windows, doors. Prism, Cylinder, Pyramid, Cone – Auxiliary Views.
Practical-3.	Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conversions.
Practical-4.	Computer Graphics: Listing the computer technologies the impact on graphical communication, Demonstration knowledge of the theory of CAD software [such as: The Menu System, Tollbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects: Isometric Views of lines, Planes, Simple and compound Solids];
Practical-5.	Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and

	tolerancing; Orthographic constraints, Snap to objects manually and automatically; Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen), Computer-aided design (CAD) software modeling of parts and assemblies.

Reference/Text Books:

1. Engineering Drawing, Bhatt N.D., Panchal V.M. & Ingle P.R. (2014), Charotar Publishing House.
2. Engineering Drawing, Narayana, K.L. & P Kannaiah (2008), Scitech Publishers.
3. Engineering Drawing Paperback, P.S. Gill (Author), S.K. Kataria & Sons.
4. Engineering Drawing and Computer Graphics, Shah, M.B. & Rana B.C. (2008), Pearson Education.
5. Engineering Graphics, Agrawal B. & Agrawal C.M. (2012), TMH Publication.
6. Engineering Graphics & Design, A.P. Gautametc, Khanna Publishing House.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce (External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Understand the basic concepts and principles of engineering graphics and their significance.	**L2 & L3**
CO-2	Understand the theory of projections and regular solids.	**L3 &L4**
CO-3	Draw the various types of projection of lines, planes and solids.	**L1& L3**
CO-4	Apply the CAD for design.	**L2 & L3**
CO-5	Creating the engineering models using solid modeling.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	0	0	0	0	1	0	0	0	2	0	0
CO-2	3	2	0	0	0	1	0	0	0	0	0	0
CO-3	3	0	3	0	1	0	0	0	0	2	0	0
CO-4	2	0	2	0	3	0	0	0	0	1	0	0
CO-5	2	0	3	1	3	0	0	0	0	0	2	0

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech (CSE)**	**Year: I** **Semester: I**
Credits: NC **Theory:** **Practical:**	**SUBJECT: SPIRITUAL AND CULTURAL HERITAGE: INDIAN EXPERIENCE**
Course Code: ENPH-111	**TITLE: SPIRITUAL AND CULTURAL HERITAGE: INDIAN EXPERIENCE**

Course Objectives:

1. To provide an overview of the foundations of Indian knowledge systems through the Vedas, Upanishads, epics, and traditional sciences.
2. To develop appreciation for India's rich heritage in art, architecture, literature, and languages.
3. To introduce the major Indian philosophical schools and contributions of spiritual thinkers.
4. To foster understanding of cultural identity and values rooted in Indian traditions
5. To highlight the modern relevance and global impact of Indian knowledge and heritage.

Nature of Paper: Audit Course (Lab)

Minimum Passing Marks/Credits: NC

L :	T : 0	P : 2	C : 0

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to Indian Knowledge Systems and Cultural Identity	**4L**
II	Vedas, Upanishads, Epics and Traditional Indian Sciences	**4L**
III	Art, Architecture, Literature and Languages of India	**4L**
IV	Indian Philosophical Schools and Spiritual Thinkers	**4L**
V	Modern Relevance and Global Impact of Indian Heritage	**4L**

Text Books:

1. The Essentials of Indian Philosophy by M. Hiriyanna. Motilal Banarsidass
2. Indian Philosophy by S. Radhakrishnan, Oxford University Press.
3. India: A Sacred Geography by Diana L. Eck. Three Rivers Press
4. The Wonder That Was India **by** A.L. Basham, Picador.
5. Cultural Heritage of India (Vols 1–5) by Ramachandra Rao, Bharatiya Vidya Bhavan

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	NA
2) Presentations /Seminar	25
3) Assignments	NA

4) Research Project Report Seminar On Research Project Report	NA
5) ESE	NA
Total:	**NA**

Prerequisites for the course: NA

Course Learning Outcomes:

CO-1	Recognize the diversity and unity of Indian cultural traditions.	**L2 & L4**
CO-2	Understand the philosophical and spiritual essence of Indian scriptures.	**L3 &L4**
CO-3	Analyze the contributions of Indian heritage to global knowledge systems.	**L3 & L4**
CO-4	Appreciate art, literature, architecture and their cultural context.	**L2 & L3**
CO-5	Develop respect for Indian values, thought, and wisdom traditions.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	1	0	1	0	1	0	0	0	0	0	0	0
CO-2	0	1	1	1	1	1	0	0	0	0	0	0
CO-3	1	1	0	1	0	0	0	0	0	0	0	0
CO-4	0	0	0	1	1	1	0	0	0	0	0	0
CO-5	0	1	1	0	0	1	0	0	0	0	0	0

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: APPLIED DIFFRENTIAL EQUATIONS**
Course Code: ENAS-121	**Title: APPLIED DIFFRENTIAL EQUATIONS**

Course Objectives:

1. To understand the effective mathematical tools for the solutions of differential equations that model physical processes.
2. To get the idea of types of partial differential equations and their solutions.
3. To understand the concept of Laplace Transform and its application to solve differential and integral equations.
4. To understand and apply the foundational knowledge and analytical skills of Fourier series in solving engineering problems.
5. To equip students with the knowledge and skills to formulate and solve linear programming problems for optimal decision-making in engineering applications.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**ORDINARY DIFFERENTIAL EQUATIONS:** Linear differential equation of nth order with constant coefficients, Simultaneous linear differential equations, Second order linear differential equations with variable coefficients, Solution by changing independent variable, Reduction of order, Normal form, Method of variation of parameters, Cauchy-Euler equation.	9L
II	**PARTIAL DIFFERENTIAL EQUATIONS:** Origin of Partial Differential Equations, Linear and Non Linear Partial Equations of first order, Lagrange's Equations, Charpit's method, Solution of Linear Partial Differential Equation of Higher order with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients.	9L
III	**LAPLACE TRANSFORM:** Laplace transform, Existence theorem, Laplace transforms of derivatives and integrals, Initial and final value theorems, Unit step function, Dirac- delta function, Laplace transform of periodic function, Inverse Laplace transform, Convolution theorem, Application to solve simple linear and simultaneous differential equations.	9L

IV	**FOURIER SERIES:** Euler's Formulae, Functions having arbitrary periods,πPeriodic functions, Fourier series of period 2 Change of interval, Even and odd functions, Half range sine and cosine series.	**9L**
V	**Linear Programming and Optimization:** Definition and importance of Linear Programming in engineering and optimization, Real-life applications of Linear Programming in various fields, Formulation of Linear Programming Problems, Solution of Linear Programming Problems using the Graphical Method, Simplex Method, Concept of duality in Linear Programming, Dual Simplex Method.	**9L**

Text Books:

1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*
4. *S.D. Sharma, Operation Research, Kedar Nath Ram Nath Publications*

Reference Books:

1. *E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.*
2. *Veerarajan T., Engineering Mathematics for first year, McGraw-Hill, New Delhi, 2008.*
3. *R K. Jain & S R K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House 2002*
4. *H.A. Taha, Operation Research-An introduction, Printice Hall of India*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Engineering Mathematics-I (RTAS-111)

Course Learning Outcomes:

CO-1	to solve linear differential equations of nth order with constant coefficients, and apply methods to solve various types of differential equations including Cauchy-Euler equations.	**L2 & L4**
CO-2	to formulate and solve first and higher-order partial differential equations using methods like Lagrange's equations, Charpit's method	**L3 &L4**
CO-3	demonstrate proficiency in using Laplace transforms to solve differential equations using theorems related to initial and final values, convolution, and the inverse Laplace transform.	**L3 & L4**
CO-4	able to represent periodic functions using Fourier series, understand and apply Euler's formulas, and construct Fourier series for functions of arbitrary periods and half-range expansions, identifying even and odd functions.	**L2 & L3**
CO-5	will develop the ability to formulate linear programming problems, solve them and understand the concept of duality in linear programming, with applications	**L2 & L4**

	to real-life optimization problems in various fields.	

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	2	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	3	3	2	0	0	0	0	0	1	3
CO-4	3	3	2	3	2	1	0	0	0	0	1	2
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**	**Year: I** **Semester: II**
Credits: NC **Theory:** **Practical:**	**SUBJECT: HEALTH AND WELLNESS**
Course Code: ENHW-121	**TITLE: HEALTH AND WELLNESS**

Course Objectives:

1. To introduce the concept and dimensions of health and wellness for a balanced lifestyle.
2. To develop awareness about nutrition, physical activity, and preventive measures against lifestyle diseases.
3. To promote mental and emotional well-being through stress management, mindfulness, and emotional intelligence.
4. To create awareness about substance abuse, its health risks, and strategies for prevention.
5. To educate students on public health practices, hygiene, first-aid, and digital wellness.

Nature of Paper: Audit Course (Lab)

Minimum Passing Marks/Credits: NC

L :	**T : 0**	**P :** 2	**C :** 0

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to Health and Wellness: Definition and dimensions of health, importance of wellness, lifestyle diseases and their prevention.	**4L**
II	Nutrition and Physical Activity: Basics of a balanced diet, nutrients and their sources, physical activity guidelines, benefits of exercise and yoga.	**4L**
III	Mental and Emotional Well-being: Understanding stress, coping mechanisms, emotional intelligence, mindfulness practices, importance of sleep.	**4L**
IV	Substance Abuse and Health Risks: Awareness about tobacco, alcohol, drugs; addiction prevention; understanding peer pressure and making informed choices.	**4L**
V	Public Health and Digital Wellness: Hygiene and sanitation, preventive healthcare, first-aid basics, digital wellness, screen time management, online health resources.	**4L**

Text Books:

1. Textbook of Health and Physical Education by Dr. V.K. Sharma, Saraswati House
2. Health and Wellness by Dr. Anjali Arora. Penguin Books India
3. The Wellness Sense by Om Swami, Jaico Publishing House
4. Essentials of Physical Education by K. Goel, Goyal Brothers Prakashan
5. Fitness and Wellness by Wener W.K. Hoeger & Sharon A. Hoeger, Cengage Learning

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	NA
2) Presentations /Seminar	25
3) Assignments	NA
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	NA
Total:	**NA**

Prerequisites for the course: NA

Course Learning Outcomes:

CO-1	Understand the importance of holistic health and identify factors affecting wellness.	**L2 & L4**
CO-2	Apply principles of nutrition and physical fitness for a healthy lifestyle.	**L3 & L4**
CO-3	Demonstrate awareness of mental and emotional health practices.	**L3 & L4**
CO-4	Recognize harmful substances and develop resistance to negative peer influence.	**L2 & L3**
CO-5	Practice good hygiene and digital wellness using available health resources.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	1	0	1	0	1	0	0	0	0	0	0	0
CO-2	0	1	1	1	1	1	0	0	0	0	0	0
CO-3	1	1	0	1	0	0	0	0	0	0	0	0
CO-4	0	0	0	1	1	1	0	0	0	0	0	0
CO-5	0	1	1	0	0	1	0	0	0	0	0	0

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Fundamental Concepts and Problem Solving with Python**
Course Code: ENCS-121	**Title: Fundamental Concepts and Problem Solving with Python**

Course Objectives:
1. To be able to introduce core programming basics.
2. To understand a range of Object-Oriented Programming, as well as in-depth data and information processing techniques.
3. To understand data types, statement, operators, modules, list, tuple, and dictionaries.

Nature of Paper: VAC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total))

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Python Programming:** History and evolution of Python, Features and advantages, Installation and setup (Python IDEs, Jupyter Notebook, Anaconda) **Basic Syntax:** Python syntax and semantics, Writing and executing a Python script, Indentation and code structure **Data Types and Variables:** Basic data types (int, float, str, bool), Variable declaration and assignment, Type conversion and casting **Operators and Expressions:** Arithmetic, relational, logical, and bitwise operators, Operator precedence and associativity.	9L
II	**Control Structures and Functions:** **Control Flow Statements:** Conditional statements (if, if-else, nested if-else), Looping statements (for, while, nested loops), Control statements (break, continue, pass), **Functions:** Defining and calling functions, Function arguments and return values, Recursion, Lambda functions and anonymous functions, **Modules and Packages:** Importing modules and using standard libraries, Creating and using custom modules, Introduction to virtual environments	9L
III	**Data Structures in Python:** **Strings:** String operations and methods, String formatting and manipulation, **Lists:** List operations and methods, List comprehensions, Nested lists, **Tuple:** Tuple operations and methods, Advantages of using tuples,	9L

	Dictionaries: Dictionary operations and methods, Dictionary comprehensions, Nested dictionaries, **Sets:** Set operations and methods, Set theory operations (union, intersection, difference)	
IV	**Problem Solving and File Handling:** **Problem Solving Techniques:** Algorithm design and pseudocode, Flowcharts, Debugging and testing, Exception handling (try, except, finally) **File Handling:** Reading from and writing to files, File methods and operations (open, close, read, write, append), Working with CSV and JSON files **Regular Expressions:** Introduction to regular expressions, Using the **re** module for pattern matching	**9L**
V	**Advanced Topics and Future Technologies:** **Object-Oriented Programming (OOP):** Classes and objects, Inheritance, polymorphism, encapsulation, and abstraction, Magic methods and operator overloading **Introduction to Data Science:** Basics of NumPy and Pandas, Data analysis and manipulation, Visualization with Matplotlib and Seaborn. **Future Prospects:** Career opportunities and industry trends, Ethical considerations in technology	**9L**

Text Books:
1. Python Crash Course.
2. Head-First Python, 2nd edition

Reference Books:
1. Guido van Rossum, and Fred L. Drake, Jr. (Editor)ISBN: 1906966141
2. Network Theory Ltd, 120 pages (Revised November 2006)

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: solid computer literacy.

Course Learning Outcomes:

CO-1	To define the structure and components of a Python program.	**L2 & L3**
CO-2	To learn how to build and package Python modules for reusability.	**L3 &L4**
CO-3	To learn how to write functions and pass arguments in Python.	**L1& L3**
CO-4	To learn how to read and write files in Python.	**L2 & L3**
CO-5	To learn how to design object-oriented programs with Python classes.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	1	0	3	0	0	0	0	0	0	1
CO-2	3	2	2	0	3	0	0	0	0	0	1	2
CO-3	3	3	2	0	3	0	0	0	0	0	0	2
CO-4	3	3	1	0	3	0	0	0	0	0	1	2
CO-5	3	3	3	0	3	2	0	0	0	0	2	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**	**Year: I** **Semester: II**
Credits: 1 **Theory: 0** **Practical: 1**	**Subject: Fundamental Concepts and Problem Solving with Python Lab**
Course Code: ENCS-121P	**Title: Fundamental Concepts and Problem Solving with Python Lab**

Course Objectives:

1. Develop proficiency in writing and executing basic Python programs
2. Implement core programming concepts including conditional statements, loops, and functions through practical tasks
3. Enhance problem-solving skills by tackling tasks such as swapping values without a third variable
4. Gain a strong grasp of data structures like lists, tuples, and dictionaries, and practice algorithms for operations like merging sorted lists, removing duplicates, and counting specific elements
5. Explore advanced Python features and libraries by creating classes, utilizing random functions

Nature of Paper: VAC (Lab)

Minimum Passing Marks/Credits: 50% marks / 1 Credits (50% of Internal Assessment&50% of External Assessment)

L: 0	**T:** 0	**P:** 2	**C:** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	**Practical Title**
Practical-1.	Write a Python program to print "Hello, World!".
Practical-2.	Implement a calculator that can perform addition, subtraction, multiplication, and division.
Practical-3.	Determine if a given year is a leap year.
Practical-4.	Swap the values of two variables without using a third variable.
Practical-5.	Check if a given string is a palindrome.
Practical-6.	Determine the maximum of three given numbers.
Practical-7.	Check if a number is an Armstrong number.
Practical-8.	Merge two sorted lists into a single sorted list.
Practical-9.	Remove duplicate elements from a list.
Practical-10.	Python program to count positive and negative numbers in a list.
Practical-11.	Python Program to Accept the Strings Which Contains all Vowels.
Practical-12.	Write a python Programming to find Maximum record value key in dictionary
Practical-13.	Python program to find tuple which have all elements divisible by K from a list of tuple

Practical-14.	Write a Python program to create a calculator class. Include methods for basic arithmetic operations.
Practical-15.	Write a Python function to find the maximum of three numbers.
Practical-16.	Write a Python program to select a random element from a list, set, dictionary-value, and file from a directory. Use random. Choice().
Practical-17.	Write a Python program to check if a function is a user-defined function or not. Use types. Function Type, types. Lambda Type().

Reference/Text Books:

- *Guido van Rossum, and Fred L. Drake, Jr. (Editor)ISBN: 1906966141*
- *Network Theory Ltd, 120 pages (Revised November 2006)*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	To Understand basic syntax of python implementation	**L2 & L3**
CO-2	To practically apply looping and conditional constructs	**L3 &L4**
CO-3	To implement program related with list data structure	**L1 & L3**
CO-4	To implement various searching algorithm in python	**L2 & L3**
CO-5	To implement list, tuple, dictionary and modules	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	1	2	1	3	1	1	1	1	1	1	1
CO-2	3	2	2	2	3	1	1	1	2	1	1	2
CO-3	3	3	2	2	3	1	1	1	2	1	1	2
CO-4	3	2	2	2	3	1	1	1	2	1	1	2
CO-5	3	2	2	3	3	1	1	1	2	1	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**	**Year: I** **Semester: II**
Credits: NC **Theory:** **Practical:**	**Subject: Sports**
Course Code: SPT-PC-111	**Title: Sports**

Course Objectives: The objectives of studying this course are

1. To develop students' physical fitness, mental well-being, and proficiency in various individual and team sports through structured participation and practice.
2. To foster qualities of discipline, teamwork, sportsmanship, and strategic thinking by engaging students in competitive and recreational games and physical activities.

Nature of Paper: Core (Practical)

Minimum Passing Marks/Credits: NC

L: 0	**T:** 0	**P:** 2	**C:** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

S.No.	Contents	No. of Lectures Allotted
1	Archery/ Athletics/ Badminton/ Basketball/ Boxing/ Carrom/ Chess/ Cricket/ Football/ Handbal/l Judo/ Kabaddi/ Kho-Kho/ Martial Arts/ Powerlifting/ Table/ Tennis/ Volleyball/ Weightlifting/ Wrestling/ Yoga.	**2L**

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	15
2) Presentation/Seminar/Viva-Voce(Internal)		-
3) External Practical Assessment	External Assessment	35
4) Presentation/Seminar/Viva-Voce(External)		-
5) Practical Records		-
Total:		**50**

Prerequisites for the course: NA

Course Learning Outcomes:

CO-1	Demonstrate basic skills, rules, and techniques required for effective participation in individual sports such as athletics, archery, boxing, and martial arts.	**L3**

CO-2	Exhibit proficiency in team-based sports like football, basketball, volleyball, kabaddi, and kho-kho, with emphasis on coordination, communication, and team strategy	**L3, L4**
CO-3	Analyze and apply rules, scoring systems, and tactics in indoor games such as chess, carrom, and table tennis to enhance cognitive and decision-making skills.	**L4**
CO-4	Develop and maintain physical fitness, flexibility, and endurance through regular practice and participation in strength-based and aerobic activities such as yoga, powerlifting, and athletics	**L3**
CO-5	Demonstrate sportsmanship, ethical behavior, self-discipline, and leadership qualities both during practice and competitive events.	**L3,L5**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	2	1	2	1	1	–	–	–	2	1	–	2
CO-2	–	1	2	–	–	–	–	–	3	2	2	2
CO-3	1	2	–	–	1	–	–	2	2	2	–	2
CO-4	–	–	–	2	–	–	2	–	1	1	–	3
CO-5	–	–	–	–	–	3	–	3	3	2	3	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech (AI-ML)**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Engineering Mathematics-III**
Course Code: RTAS-231	**Title: Engineering Mathematics-III**

Course Objectives:

- To make the students familiar with complex functions and its calculus.
- To deal with applications, residues and conformal mapping.
- To understand the concept and applications of integral transforms.
- To deal with numerical solutions of algebraic equations and differential equations.
- To understand the statistical aspect of functions.

Nature of Paper: Applied Science Courses(Core)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Functions of a Complex Variable I**: Analytic functions; C-R equations and harmonic functions; Line integral in the complex plane; Cauchy's integral theorem, Cauchy's integral formula for derivatives of analytic functions; Liouvilles theorem.	8
II	**Functions of a Complex Variable II**: Representation of a function by power series; Taylor's and Laurent's series; Singularities, zeroes and poles; Residue theorem, evaluation of real integrals; conformal mapping and bilinear transformations.	8
III	**Integral Transforms:** Fourier integral, Fourier complex transform, Fourier sine and cosine transforms and applications to simple heat transfer equations. Z – Transform and its application to solve difference equations.	8
IV	**Numerical Techniques:** Solution of polynomial and transcendental equations Bisection method, Regular – Falsi method, Newton - Raphson method. **Interpolation:** Finite difference, Newton's forward and backward interpolation, Lagrange's and Newton's divided difference formula for unequal intervals; **Numerical Differentiation**, **Numerical Integration**; Trapezoidal, Simpson's 1/3 and 3/8 rules. **Numerical solutions of first order differential equations** by Euler's method and 4th order Runge-Kutta method.	8

V	**Statistical Techniques:** Moments, Moment generating functions, Skewness, Kurtosis, Curve Fitting and Solution of Equations: Method of least squares and curve fitting of straight line and parabola, Correlation and Regression, Binomial distribution, Poisson distribution, Normal distribution.	8

Text Books:

1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*

Reference Books:

1. *E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.*
2. *R K. Jain & S R K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House 2002.*
3. *Veerarajan T., Engineering Mathematics for first year, McGraw-Hill, New Delhi, 2008.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Engineering Mathematics-I(SEAS-111)&Engineering Mathematics-II(SEAS-121)

Course Learning Outcomes:

CO-1	Understand and check the Analyticity of a complex function.	**L2 & L3**
CO-2	To apply the concept of Analytic functions in residue and conformal mappings.	**L3 &L4**
CO-3	To solve and apply the concepts of transforms in the area of engineering.	**L1& L3**
CO-4	To solve numerically the Algebraic equations, Differential equations, and to differentiate & integrate numerically.	**L2 & L3**
CO-5	To understand and use the concept of statistical tools to analyze the different data.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Engineering Mathematics-III(RTAS-231)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	2	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech. (AI-ML)**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Operating System**
Course Code: RTCS-231	**Title: Operating System**

Course Objectives:

- Student will be able to understand the structure and functions of OS
- Student will be able to learn about Processes, Threads and Scheduling algorithms.
- Student will be able to study and understand the principles of concurrency and Deadlocks
- Student will be able to study and learn various memory management scheme
- Student will be able to study I/O management and File systems.

Nature of Paper: Engineering Courses (Core)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L : 3	T : 1	P : 0	C : 4

Note: Theory - L:3
T:1
P:3(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction of Operating system and functions, Classification of Operating systems- Batch, Interactive, Time sharing, Real Time System, Multiprocessor Systems, Multiuser Systems, Multi process Systems, Multithreaded Systems. Details of Operating System Structure- Layered structure, System Components, Operating System services, Reentrant Kernels, Monolithic and Microkernel Systems. Basics of UNIX/LINUX knowledge	9L
II	Process Concept, Different states of a Process, Process State transitions, Principle of Concurrency, Producer/Consumer Problem, Mutual Exclusion, Critical Section Problem, Dekker's solution, Peterson's solution, Semaphores, Test and Set operation. Classical Problem in Concurrency i.e Dining Philosopher Problem, Overview of Inter Process Communication models and Schemes, Process generation.	9L
III	CPU Scheduling: Scheduling Concepts, Performance Criteria, Process States, Process Transition Diagram, Schedulers, Process Control Block (PCB), Process address space, Process identification information, Threads and their management, Scheduling Algorithms, Multiprocessor Scheduling. Deadlock: System model, Deadlock characterization,	9L

	Prevention, Avoidance and detection, Recovery from deadlock.	
IV	Memory Management: Basic bare machine, Resident monitor, Multiprogramming with fixed partitions, Multiprogramming with variable partitions, Protection schemes, Paging, Segmentation, Paged segmentation, Virtual memory concepts, Demand paging, Performance of demand paging, Page replacement algorithms, Thrashing, Cache memory organization, Locality of reference.	**9L**
V	I/O Management and Disk Scheduling: I/O devices, and I/O subsystems, I/O buffering, Disk storage and disk scheduling, RAID. File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed),Free-space management (bit vector, linked list, implementation(linear list, hash table), efficiency and performance.	**9L**

Reference / Text Books:

Text books:

1. Silberschatz, Galvin and Gagne, "Operating Systems Concepts", Wiley
2. Sibsankar Halder and Alex A Aravind, "Operating Systems", Pearson Education

Reference Books:

1. Harvey M Dietel, "An Introduction to Operating System", Pearson Education
2. William Stallings, "Operating Systems: Internals and Design Principles", 6th Edition, Pearson Education

If the course is available as **Generic Elective**, then the students of following departments may opt it:
NA

Evaluation/Assessment Methodology

Category	**Max. Marks**
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: NA

Course Learning Outcomes: After completion of the course, the student should be able to:

CO-1	Understand the structure and functions of OS	**L1& L2**
CO-2	Learn about Processes, Threads and Scheduling algorithms.	**L2 & L3**
CO-3	Understand the principles of concurrency and Deadlocks	**L3& L2**
CO-4	Learn various memory management scheme	**L2, L3 & L4**
CO-5	Study I/O management, Learn and implement File systems.	**L1& L2**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Operating System (RTCS-231)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	3	2	2	2	2	0	0	0	0	2
CO-2	2	3	2	3	3	1	1	0	0	0	0	2
CO-3	3	3	3	3	2	2	2	0	1	0	0	1
CO-4	3	3	3	2	2	2	2	0	0	0	0	1
CO-5	3	3	2	2	2	2	2	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech (AI-ML)**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subejct: Data Visualization**
Course Code: RTAI-231	**Title: Data Visualization**

Course Objectives:
1. To introduce the fundamentals of data analysis and visualization techniques.
2. To develop skills in using Power BI for data modeling, validation, and business intelligence.
3. To provide practical knowledge of creating dashboards and interpreting statistical data.
4. To train students in data manipulation using various types of charts and visualization tools.
5. To enable learners to perform correlation and regression analysis for data-driven decision-making.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to data handling:** Overview of Data analysis, Introduction to Data visualization, Working with statistical formulas - Logical and financial functions.	9L
II	Power BI Analytics, Data Validation & data models, Power Map for visualize data, Power BI Business Intelligence, Data Analysis using statistical methods, Dashboard designing.	9L
III	**Introduction to data manipulation using function:** Heat Map, Tree Map, Smart Chart, Azure Machine learning, Column Chart, Line Chart, Pie, Bar, Area, Scatter Chart, Data Series, Axes.	9L
IV	Chart Sheet, Trendline, Error Bars, Sparklines, Combination Chart, Gauge, Thermometer Chart, Gantt Chart, Pareto Chart.	9L
V	Frequency Distribution, Pivot Chart, Slicers, Tables: Structured References, Table Styles, What-If Analysis: Data Tables | Correlation model | Regression model.	9L

Text Books:
1. *Microsoft Power BI Quick Start Guide – Devin Knight, Brian Knight, Mitchell Pearson, 2nd Edition, Packt Publishing.*
2. *Data Visualization: A Practical Introduction – Kieran Healy, 1st Edition, Princeton University Press.*
3. *Excel Data Analysis: Your visual blueprint for analyzing data, charts, and Pivot Tables – Jinjer Simon, 3rd Edition, Wiley.*

Reference Books:
1. *Storytelling with Data: A Data Visualization Guide for Business Professionals – Cole Nussbaumer*

Knaflic, 1st Edition, Wiley.
2. *The Definitive Guide to DAX – Marco Russo & Alberto Ferrari, 2nd Edition, Microsoft Press.*
3. *Practical Business Intelligence with Power BI – Craig Dickson, 1st Edition, Apress.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max, Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Basic knowledge of programming logic, problem-solving skills, and familiarity with mathematical concepts.

Course Learning Outcomes:

CO-1	Understand the basics of data handling, analysis, and the use of logical and statistical functions.	**L1, L2 & L3**
CO-2	Apply Power BI tools for data modeling, validation, and creating business intelligence dashboards.	**L1& L3**
CO-3	Use various charts and visualization methods for effective data presentation and interpretation.	**L1,L2& L3**
CO-4	Perform advanced visual analysis using Power BI features like Heat Maps, Smart Charts, and Azure ML integration.	**L2,L3 & L4**
CO-5	Conduct statistical modeling including frequency distribution, correlation, regression, and What-If analysis.	**L2,L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Data Visualization (RTAI-231)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	1	0	0	0	1	2	3
CO-2	3	3	3	2	1	1	0	0	0	1	1	3
CO-3	3	3	3	3	1	0	0	0	0	0	1	3
CO-4	3	3	3	2	1	1	0	0	0	1	2	3
CO-5	3	3	3	3	2	1	0	0	0	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech. AI-ML**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Data Visualization Lab**
Course Code: RTAI-231P	**Title: Data Visualization Lab**

Course Objectives:

1. To introduce the fundamentals of data analysis and visualization techniques.
2. To develop skills in using Power BI for data modeling, validation, and business intelligence.
3. To provide practical knowledge of creating dashboards and interpreting statistical data.
4. To train students in data manipulation using various types of charts and visualization tools.
5. To enable learners to perform correlation and regression analysis for data-driven decision-making.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L :0	T :0	P :3	C :2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1	**Creating Basic Dashboards in Power BI**: Import data from Excel into Power BI. Create a basic dashboard with bar chart, line chart, and pie chart showing sales data across different regions.
Practical-2	**Using Statistical Functions in Excel**: Apply statistical functions like AVERAGE(), MEDIAN(), STDEV.P(), VAR.P(), and logical functions like IF(), AND(), OR() to analyze a small dataset in Excel.
Practical-3	**Power BI – Data Models & Data Validation:** Demonstrate relationships between tables in Power BI. Create a star schema using "Customers", "Orders", and "Products" tables and validate data integrity.
Practical-4	**Create a Heat Map and Tree Map in Power BI**: Visualize product category sales using Tree Map. Use conditional formatting to build a Heat Map in Excel or Power BI.
Practical-5	**Design a Frequency Distribution Table and Pivot Chart in Excel**: Create a frequency table using FREQUENCY() function or PivotTable. Use Pivot Chart to visualize the distribution of marks scored by students.
Practical-6	**Implement Regression and Correlation Models in Excel**: Use Excel's Data Analysis Toolpak to run correlation and regression analysis between advertisement spend and product sales.
Practical-7	**Designing Interactive Dashboards Using Slicers**: Create interactive dashboards in Excel or Power BI with slicers and filters to dynamically analyze data based on months, product categories, or regions.
Practical-8	**Using Smart Charts and Advanced Chart Types**: Create advanced charts such as Gantt Chart (for project management), Thermometer Chart (for KPIs), and Combo Chart (for comparison) in Excel.
Practical-9	**Forecasting with Trendline and Sparklines** Add Trendlines to a sales chart to show forecasting. Use Sparklines in cells to show

	sales trends over time.
Practical-10	**Data Visualization Using Power Map (3D Maps):** Use Excel's 3D Maps (Power Map) to visualize geographic data (e.g., sales by location or population distribution) using map-based animation and scenes.

Reference / Text Books:

1. *Microsoft Power BI Quick Start Guide – Devin Knight, Brian Knight, Mitchell Pearson, 2nd Edition, Packt Publishing.*
2. *Data Visualization: A Practical Introduction – Kieran Healy, 1st Edition, Princeton University Press.*
3. *Excel Data Analysis: Your visual blueprint for analyzing data, charts, and Pivot Tables – Jinjer Simon, 3rd Edition, Wiley.*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Understand the basics of data handling, analysis, and the use of logical and statistical functions.	**L3**
CO-2	Apply Power BI tools for data modeling, validation, and creating business intelligence dashboards.	**L3**
CO-3	Use various charts and visualization methods for effective data presentation and interpretation.	**L3**
CO-4	Perform advanced visual analysis using Power BI features like Heat Maps, Smart Charts, and Azure ML integration.	**L3 & L4**
CO-5	Conduct statistical modeling including frequency distribution, correlation, regression, and What-If analysis.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Data Visualization Lab (RTAI-231 P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	1	0	0	0	1	2	3
CO-2	3	3	3	2	1	1	0	0	0	1	1	3
CO-3	3	3	3	3	1	0	0	0	0	0	1	3
CO-4	3	3	3	2	1	1	0	0	0	1	2	3
CO-5	3	3	3	3	2	1	0	0	0	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech (AI-ML)**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Statistical Modeling and Data Reasoning with Python**
Course Code: RTAI-232	**Title: Statistical Modeling and Data Reasoning with Python**

Course Objectives:
1. To introduce the fundamental concepts and applications of statistics in scientific research.
2. To develop a solid understanding of probability theory and probability distributions.
3. To explain point and interval estimation techniques along with their properties.
4. To familiarize students with hypothesis testing methods and Bayesian inference.
5. To provide hands-on experience in statistical analysis using Python.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Statistics:** Introduction to Statistics. Role of statistics in scientific methods, current applications of statistics. **Scientific data gathering:** Sampling techniques, scientific studies, observational studies, data management. **Data description:** Displaying data on a single variable (graphical methods, measure of central tendency, measure of spread), displaying relationship between two or more variables, measure of association between two or more variables.	9L
II	**Probability Theory:** Sample space and events, probability, axioms of probability, independent events, conditional probability, Bayes' theorem. **Random Variables:** Discrete and continuous random variables. Probability distribution of discrete random variables, binomial distribution, poisson distribution. Probability distribution of continuous random variables, The uniform distribution, normal (gaussian) distribution, exponential distribution, gamma distribution, beta distribution, t-distribution, χ^2 distribution. Expectations, variance and covariance. Probability Inequalities. Bivariate distributions.	9L
III	**Point Estimations:** Methods of finding estimators, method of moments, maximum likelihood estimators, bayes estimators. Methods of evaluating estimators, mean squared error, best unbiased estimator, sufficiency and unbiasedness.	9L

IV	**Interval Estimations:** Confidence interval of means and proportions, Distribution free confidence interval of percentiles. **Test of Statistical Hypothesis and p-values:** Tests about one mean, tests of equality of two means, test about proportions, p-values, likelihood ratio test, Bayesian tests.	**9L**
V	**Bayesian Statistics:** Bayesian inference of discrete random variable, Bayesian inference of binomial proportion, comparing Bayesian and frequentist inferences of proportion, comparing Bayesian and frequentist inferences of mean. **Univariate Statistics using Python:** Mean, Mode. Median, Variance, Standard Deviation, Normal Distribution.	**9L**

Text Books:

1. *Probability and Statistics for Engineers and Scientists* – Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, 9th Edition, Pearson.
2. *Statistical Inference* – George Casella and Roger L. Berger, 2nd Edition, Cengage Learning.
3. *Think Stats: Exploratory Data Analysis in Python* – Allen B. Downey, 2nd Edition, O'Reilly Media.

Reference Books:

1. *Introduction to the Practice of Statistics – David S. Moore, George P. McCabe, Bruce Craig, 9th Edition, W.H. Freeman.*
2. *All of Statistics: A Concise Course in Statistical Inference – Larry Wasserman, 1st Edition, Springer.*
3. *Practical Statistics for Data Scientists – Peter Bruce, Andrew Bruce, Peter Gedeck, 2nd Edition, O'Reilly Media.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max, Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Basic knowledge of programming logic, problem-solving skills, and familiarity with mathematical concepts.

Course Learning Outcomes:

CO-1	Understand the role of statistics in scientific research and apply basic data description techniques.	**L1, L2 & L3**
CO-2	Apply fundamental concepts of probability theory and work with various probability distributions.	**L1, L2 & L3**
CO-3	Estimate statistical parameters using methods like moments, maximum likelihood, and Bayesian estimation.	**L1, L2 & L3**
CO-4	Conduct hypothesis testing and interpret p-values and confidence intervals in various scenarios.	**L2, L3 & L4**

CO-5	Perform univariate statistical analysis using Python and interpret the results effectively.	**L2, L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Statistical Modelling and Data Reasoning with Python (RTAI-232)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	1	0	0	0	1	2	3
CO-2	3	3	3	2	1	1	0	0	0	1	1	3
CO-3	3	3	3	3	1	0	0	0	0	0	1	3
CO-4	3	3	3	2	1	1	0	0	0	1	2	3
CO-5	3	3	3	3	2	1	0	0	0	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech. (AI-ML)**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Statistical Modeling and Data Reasoning with Python Lab**
Course Code RTAI-232P	**Title: Statistical Modeling and Data Reasoning with Python Lab**

Course Objectives:
1. To introduce the fundamental concepts and applications of statistics in scientific research.
2. To develop a solid understanding of probability theory and probability distributions.
3. To explain point and interval estimation techniques along with their properties.
4. To familiarize students with hypothesis testing methods and Bayesian inference.
5. To provide hands-on experience in statistical analysis using Python.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L :0	T :0	P :3	C :2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	**Descriptive Statistics using Python:** Write a Python program using numpy and statistics modules to calculate mean, median, mode, variance, and standard deviation for a given dataset.
Practical-2.	**Graphical Representation of Data**: Use matplotlib and seaborn to create bar charts, histograms, box plots, and pie charts to visualize categorical and numerical data distributions.
Practical-3.	**Probability Calculations**: Write Python code to simulate coin tosses or dice rolls. Calculate empirical and theoretical probabilities. Use random module for simulations.
Practical-4.	**Bayes' Theorem Implementation:** Implement a Python program to calculate conditional probabilities using Bayes' Theorem. Use real-world examples like disease diagnosis or spam filtering.
Practical-5.	**Discrete Probability Distributions:** Write Python programs using scipy.stats to work with binomial and Poisson distributions. Calculate PMF, mean, variance, and plot the distribution.
Practical-6.	**Continuous Probability Distributions**: Use scipy.stats to model and visualize normal, exponential, and uniform distributions. Plot the PDF and CDF using matplotlib.
Practical-7.	**Confidence Interval Calculation**: Use Python to compute confidence intervals for the population mean and proportion using sample data. Compare different confidence levels (e.g., 90%, 95%, 99%).
Practical-8.	**Hypothesis Testing: t-test & z-test:** Perform one-sample and two-sample t-tests using scipy.stats.ttest_ind or ttest_1samp. Use real datasets and interpret p-values.
Practical-9.	**Chi-Square Test for Independence:** Use scipy.stats.chi2_contingency to perform the chi-square test on a contingency table. Interpret the results and determine independence

	between variables.
Practical-10.	**Univariate Statistics on Real Data:** Import a real-world dataset (e.g., from CSV), compute univariate statistics, check for normality, plot histograms, and interpret results using statistical principles.

Reference / Text Books:

1. *Probability and Statistics for Engineers and Scientists* – Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, 9th Edition, Pearson.
2. *Statistical Inference* – George Casella and Roger L. Berger, 2nd Edition, Cengage Learning.
3. Think Stats: Exploratory Data Analysis in Python – *Allen B. Downey, 2nd Edition, O'Reilly Media.*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Understand the role of statistics in scientific research and apply basic data description techniques.	**L3**
CO-2	Apply fundamental concepts of probability theory and work with various probability distributions.	**L3**
CO-3	Estimate statistical parameters using methods like moments, maximum likelihood, and Bayesian estimation.	**L3**
CO-4	Conduct hypothesis testing and interpret p-values and confidence intervals in various scenarios.	**L3 & L4**
CO-5	Perform univariate statistical analysis using Python and interpret the results effectively.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Statistical Modeling and Data Reasoning with Python Lab (RTAI-232P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	1	0	0	0	1	2	3
CO-2	3	3	3	2	1	1	0	0	0	1	1	3
CO-3	3	3	3	3	1	0	0	0	0	0	1	3
CO-4	3	3	3	2	1	1	0	0	0	1	2	3
CO-5	3	3	3	3	2	1	0	0	0	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech. (AI-ML)**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Digital Logic Circuit**
Course Code: RSAI-231	**Title: Digital Logic Circuit**

Course Objectives:

1. To develop a strong foundation in analysis, design and implementation of digital electronic circuits.
2. To present the Digital fundamentals, Boolean algebra and its applications in digital systems
3. To familiarize with the design of various combinational digital circuits using logic gates
4. To introduce the analysis and design procedures for synchronous and asynchronous sequential circuit

Nature of Paper: Skill Enhancement Courses (SEC-3)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L : 3	T : 0	P : 0	C : 2

Note: Theory - L:3 T:1 P:3(In Hours/Week) Theory - 1 Hr. = 1 Credit Practical- 2 Hrs.=1Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Digital System and Binary Numbers**: Number System and its arithmetic, Signed Magnitude Form (1's & 2's Compliment Form), Boolean Algebra, Binary codes, Logic Gates, NAND and NOR Gates implementation, Karnaugh Map Method(K-Map) up to four variable.	6L
II	**Combinational Circuits:** Basic Concepts**,** Binary Adder, Subtractor, Adder & Subtractor, Magnitude Comparator, Multiplexers, Demultiplexers, Decoders, Encoders.	6L
III	**Sequential Circuits:** Flip-flop and Latch, SR flip-flop, JK flip-flop, T flip-flop, D flip-flop, **Registers:** (SISO, PIPO).	6L
IV	**Counters:** Asynchronous/Ripple counters, Synchronous counters, Ring counter, Johnson counter	6L

Text Books:

1. M. Morris Mano and M. D. Ciletti, "Digital Design", Pearson Education.
2. David J. Comer, "Digital Logic & State Machine Design", Oxford University Press.

Reference Books:

1. RP Jain, "Modern Digital Electronics", Tata McGraw Hill Publication.
2. Charles H Roth (Jr), Larry L. Kinney, "Fundamentals of Logic Design", Cengage Learning India Edition, 5th Edition, 2010.

If the course is available as **Generic Elective**, then the students of following departments may opt it:
NA

Evaluation/Assessment Methodology	
Category	**Max. Marks**
1) Class tasks/ Sessional Examination	10
2) Presentations /Seminar	NA
3) Assignments	5
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	35
Total:	**50**

Prerequisites for the course: NA

Course Learning Outcomes: After completion of the course, the student should be able to:

CO-1	Understand the concept of number system, Logic Gates, Boolean algebra, K-map.	**L1& L2**
CO-2	Design of combinational logic circuits and their applications.	**L2 & L3**
CO-3	Understand concepts of Flip-Flops& Registers under the Sequential Circuits.	**L3& L2**
CO-4	Design of various Synchronous & Asynchronous Counters.	**L3 & L4**
CO-5	Gain the knowledge of designing & implementation of PLDs.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Digital Logic Circuit (RSAI-231)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	3	2	2	2	2	0	0	0	0	2
CO-2	2	3	2	3	3	1	1	0	0	0	0	2
CO-3	3	3	3	3	2	2	2	0	1	0	0	1
CO-4	3	3	3	2	2	2	2	0	0	0	0	1
CO-5	3	3	2	2	2	2	2	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech. (AI-ML)**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Operating System Lab**
Course Code: RTCS-231P	**Title: Operating System Lab**

Course Objectives:
1. To learn shell programming and the use of filters in the LINUX environment.
2. To practice multithreaded programming.
3. To implement CPU Scheduling Algorithms and memory management algorithms.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 3	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Write C programs to simulate the following CPU scheduling algorithms. a) FCFS b) SJF c) Round Robin d) Priority.
Practical-2.	Write a C program to simulate producer-consumer problem using Semaphores.
Practical-3.	Write a C program to simulate the concept of Dining-philosophers problem.
Practical-4.	Write a C program to simulate the following contiguous memory allocation Techniques a) Worst fit b) Best fit c) First fit.
Practical-5.	Write C programs to simulate all page replacement algorithms a)FIFO b) LRU c) OPTIMAL
Practical-6.	Write C programs to simulate all File Organization Techniques a) Single level directory b) Two level directory
Practical-7.	Write a C program to simulate all file allocation strategies a) Sequential b) Indexed c) Linked.
Practical-8.	Write a C program to simulate Bankers Algorithm for Deadlock Avoidance.
Practical-9.	Write a C program to simulate Bankers Algorithm for Dead Lock Prevention.
Practical-10.	Write a C program to simulate disk scheduling algorithms. a) FCFS b) SCAN c) C-SCAN

Reference/Text Books:
1. R. Kruse etal, "Data Structures and Program Design in C", Pearson Education.
2. Berztiss, AT: Data structures, Theory and Practice, Academic Press.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	**Implement basic operating system functionalities** such as process creation, scheduling, memory allocation, and file handling through programs in C or equivalent programming language.	**L3 & L4**
CO-2	**Simulate CPU scheduling algorithms** (FCFS, SJF, Priority, Round Robin) and analyze their performance in terms of waiting time and turnaround time.	**L4**
CO-3	**Develop programs to handle process synchronization** using semaphores, mutexes, and implement classic problems such as Producer-Consumer, Reader-Writer, and Dining Philosophers.	**L3**
CO-4	**Demonstrate memory management techniques** such as paging, segmentation, and page replacement algorithms.	**L3 & L4**
CO-5	**Apply system calls for process and file management** to gain familiarity with UNIX/Linux OS environments.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Operating System Lab (RTCS-231P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	2	0	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	2	2	1	0	0	0	0	0	0	2	2
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech. (AI-ML)**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Switching Theory Lab**
Course Code: RSAI-231P	**Title: Switching Theory Lab**

Course Objectives:
The objectives of studying this course are-
1. Students will be able to analyze and do some simple design of combinational logic.
2. Students will examine the various logic gates and circuits in the laboratory. They will design, build and troubleshoot logic circuits in the laboratory.
3. Students will be able to analyze and do some simple design of sequential logic. They will be familiar with and incorporate into circuits the latches, flip-flops, and counters.

Nature of Paper: AECC-3

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Pract. 1	Introduction to digital electronics lab- verification of the truth tables of logic gates.
Pract. 2	Design and implementation of Adder and Subtractor using logic gates.
Pract. 3	Design and implementation of 2 bit Magnitude Comparator using logic gates.
Pract. 4	Design and implementation of Decoder using logic gates.
Pract. 5	Design and implementation of Encoder using logic gates.
Pract. 6	Design and implementation of Multiplexer using logic gates.
Pract. 7	Design and implementation of De-multiplexer using logic gates.
Pract. 8	Verification of state tables of RS and JK flip-flops using NAND gates.
Pract. 9	Verification of state tables of T and D flip-flops using NAND gates.
Pract. 10	Construction and verification of shift registers.

Text Books:
1. M. Morris Mano and M. D. Ciletti, "Digital Design", Pearson Education.
2. David J. Comer, "Digital Logic & State Machine Design", Oxford University Press.

Reference Books:
1. RP Jain, "Modern Digital Electronics", Tata McGraw Hill Publication.
2. Charles H Roth (Jr), Larry L. Kinney, "Fundamentals of Logic Design", Cengage Learning India Edition, 5th Edition, 2010.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Understand the Digital Binary System and implementation of Gates.	**L3 & L4**
CO-2	Understand and design combinational and sequential systems.	**L4**
CO-3	Design the counters with the help of sequential circuit and basic Gates.	**L3**
CO-4	Understand concepts of digital integrated circuits.	**L3 & L4**
CO-5	Implement the projects using the digital ICs and electronics components.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Digital Logic Circuit Lab (RSAI-231P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	1	2	0	0	0	0	1	0	2
CO-2	3	3	2	1	2	0	0	0	0	1	0	2
CO-3	3	3	2	2	2	0	0	0	0	1	0	2
CO-4	3	3	2	1	2	0	0	0	0	1	0	2
CO-5	3	3	2	2	2	0	0	0	0	1	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech (AI-ML)**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Data Structure Using C Lab**
Course Code: RTCS-242P	**Title: Data Structure Using C Lab**

Course Objectives:

- To write and execute programs in C to solve problems using data structures such as arrays, linked lists, stacks, queues.
- To write and execute programs in C to solve problems using data¬ structures such as trees, graphs, hash tables and search trees.
- To write and execute write programs in C to implement various¬ sorting and searching methods.

Nature of Paper: CORE (LAB)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	**T :** 0	**P :** 3	**C : 2**

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	**Practical Title**
Practical-1.	Implementation of Stack using Array.
Practical-2.	Implementation of Queue using Array.
Practical-3.	Implementation of Circular Queue using Array.
Practical-4.	Implementation of Stack using Linked List.
Practical-5.	Implementation of Queue using Linked List.
Practical-6.	Implementation of Circular Queue using Linked List.
Practical-7.	Write a program that implements the following i) Insertion sort ii) Merge sort iii) Heap sort.
Practical-8.	Write a program that implements the following sorting i) Bubble sort ii) Selection sort iii) Quick sort.
Practical-9.	Implementation of Tree Structures, Binary Tree, Tree Traversal, Binary Search BST Tree, Insertion and Deletion in BST.
Practical-10.	Graph Implementation, BFS, DFS, Minimum cost spanning tree, shortest path algorithm.

Reference / Text Books:
Text books:

1. R. Kruse etal, "Data Structures and Program Design in C", Pearson Education.
2. Berztiss, AT: Data structures, Theory and Practice, Academic Press.

Reference Books:

1. Aaron M. Tenenbaum, YedidyahLangsam and Moshe J. Augenstein, "Data Structures Using C and C++", PHI Learning Private Limited, Delhi India
2. Horowitz and Sahani, "Fundamentals of Data Structures", Galgotia Publications Pvt Ltd Delhi India.
3. Lipschutz, "Data Structures" Schaum's Outline Series, Tata McGraw-hill Education (India) Pvt. Ltd.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce (External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Be able to design and analyze the time and space efficiency of the data structure	**L3**
CO-2	Be capable to identity the appropriate data structure for given problem	**L4**
CO-3	Have practical knowledge on the applications of data structures.	**L3**
CO-4	Be able to do Graph Implementation, BFS, DFS, Minimum cost spanning tree, shortest path algorithm.	**L3 & L4**
CO-5	Be able to Implement Tree Structures, Binary Tree, Tree Traversal, Binary Search BST Tree, Insertion and Deletion in BST.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Data Structures using C Lab (RTCS-242P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	2	3	3	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	2	3	3	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech (AI-ML)**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subejct: Machine Learning and Pattern Recognition**
Course Code: RTAI-241	**Title: Machine Learning and Pattern Recognition**

Course Objectives:
1. To introduce the fundamental concepts and types of machine learning.
2. To explain key theoretical aspects like model complexity, overfitting, and bias-variance trade-off.
3. To develop understanding of linear regression techniques and their applications.
4. To explore classification algorithms including logistic regression and discriminant analysis.
5. To prepare students for applying machine learning models to real-world problems.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L :3	T :1	P :0	C :4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Learning systems, real world applications of machine learning, why machine learning, variable types and terminology, function approximation.	9L
II	**Types of machine learning:** Supervised learning, unsupervised learning, reinforcement learning. Parametric vs non-parametric models	9L
III	**Important concepts of machine learning:** The trade-off between prediction accuracy and model interpretability, the curse of dimensionality, measuring the quality of fit, bias-variance trade off, overfitting, model selection, no free lunch theorem.	9L
IV	**Linear Regression:** Linear regression, estimating the coefficients, accessing the accuracy of coefficient estimates, accessing the accuracy of the model, multiple linear regression, qualitative predictors.	9L
V	**Classification:** Logistic regression, estimating regression coefficients, making predictions, multiple logistic regressions, linear discriminant analysis, bayes' theorem of classification, LDA for p=1, LDA for p>1, quadratic discriminant analysis.	9L

Text Books:
1. *An Introduction to Statistical Learning – Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, 2nd Edition, Springer.*
2. *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow – Aurélien Géron, 2nd Edition, O'Reilly Media.*
3. *Machine Learning – Tom M. Mitchell, 1st Edition, McGraw-Hill.*

Reference Books:

1. *Pattern Recognition and Machine Learning – Christopher M. Bishop, 1st Edition, Springer.*
2. *The Elements of Statistical Learning – Trevor Hastie, Robert Tibshirani, Jerome Friedman, 2nd Edition, Springer.*
3. *Machine Learning: A Probabilistic Perspective – Kevin P. Murphy, 1st Edition, MIT Press.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max, Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Basic knowledge of programming logic, problem-solving skills, and familiarity with mathematical concepts.

Course Learning Outcomes:

CO-1	Understand the basic principles, types, and real-world applications of machine learning.	**L1, L2 & L3**
CO-2	Explain key machine learning concepts such as model selection, overfitting, and the bias-variance trade-off.	**L1,L2& L3**
CO-3	Apply linear regression models to predict continuous outcomes and interpret coefficients.	**L1,L2& L3**
CO-4	Implement and analyze logistic regression for classification problems.	**L2,L3 & L4**
CO-5	Utilize advanced classification techniques like LDA and QDA for high-dimensional data.	**L2,L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Machine Learning and Pattern Recognition (RTAI-241)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	1	0	0	0	1	2	3
CO-2	3	3	3	2	1	1	0	0	0	1	1	3
CO-3	3	3	3	3	1	0	0	0	0	0	1	3
CO-4	3	3	3	2	1	1	0	0	0	1	2	3
CO-5	3	3	3	3	2	1	0	0	0	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech(AI-ML)**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: AI Product Development and Deployment**
Course Code: RTAI-242	**Title: AI Product Development and Deployment**

Course Objectives:
1. To understand the process of AI prototyping, stakeholder alignment, and ethical AI practices.
2. To gain knowledge of model optimization, packaging, and ensuring reproducibility in AI systems.
3. To explore scalable deployment architectures, containerization, and cloud-edge integration.
4. To develop monitoring and CI/CD workflows for maintaining AI systems in production.
5. To evaluate business integration, AI ROI, and strategies for successful AI project implementation.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C :4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**AI Product Prototyping: Strategy, Experimentation, and Responsible Design** Problem Definition & Stakeholder Alignment: Define Stakeholders, Business and Technical Requirement, Feasibility Analysis, KPIs, Data Strategy & Prototyping: What is Prototype, Rapid-Prototype Workflow, Jupyter Notebook, Sreamlit, Gradio, Generate Synthetic Data with Faker, Greetal.ai, Model Prototyping & Experimentation: Protype Models, Multiple Model, Baseline Model, Moving to Advanced Model, Track Experiments, MLFlow, Ethics & Bias in Prototyping: Bias in AI, How Bias Sneaks, Spotting Bias Early, Fairlearn, Aequitas, Key Fairness Metrics	9L
II	**Production-Ready AI Optimization, Packaging, and Reproducibility** Model Optimization: Hyperparameter Tuning, Model Pruning, Quantization, Knowledge Distillation, TinyML Optimization, ONNX for Portability, Quantization-Aware Training (QAT), Model Packaging: Package Models,Packaging Formats, MLflow Models, MLflow Packaging Docker, Docker Packaging, PMML, PMML Packaging,pip requirements, conda environemnt, Reproducibility & Versioning: Tools, Git, DVC Commands, Combining Git and DVC, Versioning Models, Versioning Environment	9L
III	**Scalable AI Deployment: Architectures, Containers & Edge Systems**Deployment Architecture: What is Deployment, Deployment	9L

	Methods, REST API, FastAPI, Batch Processing, Tools for Batch Jobs, Serverless, AWS Lambda, Model Serving Frameworks, Containerization & Orchestration: What is Container, Packaging vs Containerization, Dockerfile, Docker Compose, Orchestration, What is Kubernetes (K8), Pod in Kubernetes, Kubernetes Cluster Components, Master Node, Worker Node, Kubelet, Deployment YAML,Replicas,Cloud vs Edge Deployment: Why Reproducibility Matters, Cloud Deployment vs Edge Deployment, When to use, AWS Sage Maker, Google Vertex AI, ONNX runtime, Hybrid Deployment.	
IV	**AI in Production: Monitoring, CI/CD, and Business Integration** Monitoring & Observability: What is Monitoring, Monitoring vs. Logging vs. Observability, Logs, Metrics, and Alerts, Open-Source Tools for Monitoring ML, Prometheus, Grafana, Evidently AI, CI/CD for AI Systems: What is CI/CD, Key Components, Automated Retraining, Data Drift & Triggering Retrain, Apache Airflow, Kuberflow.	**9L**
V	**Business Integration & ROI in AI :**What is AI ROI, What AI Project Fail, Successful AI Project, Measuring ROI with KPI.	**9L**

Text Books:

1. *Designing Machine Learning Systems with Python* – David Julian, 1st Edition, O'Reilly Media.
2. *Machine Learning Engineering* – Andriy Burkov, 1st Edition, True Positive Inc.
3. *Building Machine Learning Powered Applications* – Emmanuel Ameisen, 1st Edition, O'Reilly Media**.**

Reference Books:

1. *Introducing MLOps – Mark Treveil & Alok Shukla, 1st Edition, O'Reilly Media.*
2. *Reliable Machine Learning: Applying SRE Principles to ML in Production – Cathy Chen, 1st Edition, O'Reilly Media.*
3. *Hands-On MLOps – Mark Treveil, Alok Shukla et al., Packt Publishing, 1st Edition.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max, Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Basic understanding of Python programming, machine learning fundamentals, and software development tools like Git and Jupyter Notebook.

Course Learning Outcomes:

CO-1	Define and align AI problem statements with business and stakeholder requirements, and create rapid prototypes.	**L1, L2 & L3**
CO-2	Optimize models and package them using modern tools like MLflow, Docker,	**L1 & L3**

	and ONNX for reproducibility.	
CO-3	Design deployment strategies using REST APIs, Kubernetes, and compare cloud vs edge deployments.	**L1, L2 & L3**
CO-4	Implement monitoring, alerting, and CI/CD pipelines using tools like Prometheus, Grafana, and Apache Airflow.	**L2, L3 & L4**
CO-5	Analyze the success of AI integration into business systems and measure return on investment through KPIs.	**L2, L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
AI Product Development and Deployment (RTAI-242)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	3	2	2	1	0	0	0	1	2	3
CO-2	3	3	3	2	1	1	0	0	0	1	1	3
CO-3	3	3	3	3	1	0	0	0	0	0	1	3
CO-4	3	3	3	2	1	1	0	0	0	1	2	3
CO-5	3	3	3	3	2	1	0	0	0	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech (AI-ML)**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Data Structures Using C**
Course Code: RTCS-242	**Title: Data Structures Using C**

Course Objectives:

1. Student will be able to describe how arrays, linked lists, stacks, queues, trees, and graphs are represented in memory, used by the algorithms and their common applications.
2. Student will be able to discuss the computational efficiency of the sorting and searching algorithms.
3. Student will be able to implement trees and Graphs and perform various operations on these data structure.
4. Student will be able to understand the concept of recursion, application of recursion and its implementation and removal of recursion.
5. Student will be able to identify the alternative implementations of data structures with respect to its performance to solve real world problems.

Nature of Paper: Engineering Courses (Core)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit (40% Marks / 4 Credits Hrs./Week=40% Marks / 4 Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Basic Terminology, Elementary Data Organization, Built in Data Types available in C. Overview of Algorithms, Efficiency of an Algorithms and its time and space complexity. Asymptotic notations: Big Oh, Big Theta and Big Omega, Discussion on Time-Space trade-off, Introduction to Abstract Data Types (ADT). **Arrays**: Definition and types: Single and Multidimensional Arrays, Representation of Arrays: Row Major Order, and Column Major Order, Derivation of Index Formulae for 1-D,2-D,3-D and n-D Arrays, Application of arrays, Sparse Matrices and their representations. **Linked lists:** Array Implementation and Pointer Implementation of Singly Linked Lists, Doubly Linked List, Circularly Linked List, Operations on a Linked List. Insertion, Deletion, Traversal, Polynomial Representation and Addition, Subtraction & Multiplications of Single variable & Two variables polynomial.	**9L**
II	**Stacks:** Abstract Data Type, Primitive Stack operations: Push & Pop, Array and Linked Implementation of Stack in C, Application of stack: Prefix and Postfix Expressions, Evaluation of postfix expression,	**9L**

	Iteration and Recursion- Principles of recursion, Tail recursion, Removal of recursion Problem solving using iteration and recursion with examples such as binary search, Fibonacci numbers, and Hanoi towers. Tradeoffs between iteration and recursion. **Queues:** Operations on Queue: Create, Add, Delete, Full and Empty, Circular queues, Array and linked implementation of queues in C, Dequeue and Priority Queue	
III	**Searching:** Concept of Searching and types of searching: Sequential search, Index Sequential Search, Binary Search. Concept of Hashing & Collision resolution Techniques used in Hashing. **Sorting:** Insertion Sort, Selection, Bubble Sort, Quick Sort, Merge Sort, Heap Sort and Radix Sort.	**9L**
IV	**Graphs:** Terminology used with Graph, Data Structure for Graph representations by using C: Adjacency Matrices and Adjacency List. Graph Traversal: Depth First Search and Breadth First Search, Connected Component, Spanning Trees, Minimum Cost Spanning Trees: Prims and Kruskal algorithm. Transitive Closure and Shortest Path algorithm: Warshal Algorithm and Dijkastra Algorithm.	**9L**
V	**Trees:** Basic terminology used with Tree, Binary Trees, Binary Tree Representation: Array Representation and Pointer (Linked List) Representation, Binary Search Tree, Strictly Binary Tree, Complete Binary tree. Extended Binary Trees, Tree Traversal algorithms: In order, Preorder and Post order, Constructing Binary Tree from given Tree Traversal, Operation of Insertion, Deletion, Searching & Modification of data in Binary Search. Threaded Binary trees, Traversing Threaded Binary trees, Huffman coding using Binary Tree, Concept & Basic Operations for AVL Tree, B Tree & Binary Heaps.	**9L**

Text Books:

1. Lipschutz, "Data Structures"Schaum's Outline Series, Tata Mc Graw-hill Education (India) Pvt. Ltd.
2. A K Sharma,"Data Structure Using C", Pearson Education India.
3. Aaron M. Tenenbaum, Yedidyah Langsam and Moshe J.Augenstein, "Data Structures Using C and C++",PHI Learning Private Limited, Delhi India.

Reference Books:

1. Horowitzand Sahani, "Fundamentals of Data Structures", Galgotia Publications Pvt. Ltd. Delhi India.
2. Thareja, "Data Structure Using C "Oxford Higher Education.
3. Michael T. Goodrich, Roberto Tamassia, David M. Mount "Data Structures and Algorithms in C++", Wiley India.

If the course is available as Generic Elective, then the students of following departments may opt it: NO

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA

3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes: After completion of the course, the student should be able to:

CO-1	Describe how arrays, linked lists, stacks, queues, trees, and graphs are represented in memory, used by the algorithms and their common applications.	**L3 & L4**
CO-2	Discuss the computational efficiency of the sorting and searching algorithms.	**L4**
CO-3	Implementation of Trees and Graphs and perform various operations on these data structure.	**L1 & L3**
CO-4	Understanding the concept of recursion, application of recursion and its implementation and removal of recursion.	**L2 & L4**
CO-5	Identify the alternative implementations of data structures with respect to its performance to solve a real world problem.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Data Structures Using C (RTCS-242)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech. (CSE/AI-ML)**	**Year: II** **Semester: IV**
Credits: 2 **Theory: 2** **Practical: 0**	**Subject: Indian Ethos and Modern Management**
Course Code: IEMM-402	**Title: Indian Ethos and Modern Management**

Course Objectives:
1. To understand the concept of Indian Ethos in Management
2. To link the Traditional Management System to Modern Management System
3. To understand the Techniques of Stress Management
4. To understand the Evolution of Learning Systems in India
5. To motivate learners to research further on Indian Culture.

Nature of Paper: VAC- 3

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L : 3	T : 0	P : 0	C : 2

Note: Theory - L:3 T:0 P:3 (In Hours/Week)

Unit	Contents	No. of Lectures Allotted
I	Meaning, Features, Need, History, Relevance, Principles Practiced by Indian Companies, Requisites, Elements, Role of Indian Ethos in Managerial Practices, Indian Heritage in Business Management, Ethics v/s Ethos, Indian Vs Western Management.	9
II	**Chankaya's Philosophy – A Way to Personal and Public Victory and Management:** Application and Impact of Chanakya's Philosophy in Personal life, Achieving success in professional life with Chankaya, Corporate Chanakya.	9
III	**Management Lessons from Indian Scriptures–I:** Management Lessons from Mahabharata, Management lessons from Geeta, Management Lessons from Ramayana **Management Lessons from Indian Scriptures–II:** Management Lessons from the Vedas, Management Lessons from the Bible, and Management Lessons from the Quran.	9
IV	**Indian Systems of Learning:** Modern System of Learning: Meaning, Features, Advantages, Disadvantages. Karma: Meaning, Importance of Karma to Managers, Nishkama Karma. Laws of Karma: The Great Law, Law of Creation, Law of Humility, Law of Growth, Law of Responsibility, Law of Connection. Corporate Karma: Meaning, Methodology, Guidelines for Good Corporate Karma. Self-management: Personal Growth and Lessons from Ancient Indian	9

	Education System.	
V	Relevance of Value-based& Ethics Based Management in Global Change Developing Code of Culture in Organization, Ethical, and Value-Based Leadership, the impact of Values on stakeholders; Trans-cultural human values; Secular - Vs Spiritual values; value system in work culture.	**9**

Reference / Text Books:

1. "Indian Ethos and Values in Management" by R.C. Sharma
2. "Management and Indian Ethos" by Subhash Sharma
3. "The Bhagavad Gita: A New Commentary for Modern Readers" by Eknath Easwaran
4. "Indian Ethos in Management" by N. M. Khandwalla
5. "Management and the Indian Ethos" by G. P. Rao
6. "Indian Ethos and Values for Managers" by B. L. Bajpai

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NA**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	10
2) Presentations /Seminar	NA
3) Assignments	05
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	35
Total:	**50**

Prerequisites for the course: Probabilistic Modeling and Reasoning with Python Programming basics

Course Learning Outcomes: After completion of the course, the student should be able to:

CO-1	Understand the various elements of Indian ethos and management lessons from Indian scriptures	**L1& L2**
CO-2	Know the work ethos and values and its relevance management.	**L2 & L3**
CO-3	Deal with varied ethical dilemma at workplace and explore the impact of moral philosophies in ethical decision making	**L3& L2**
CO-4	Explore the significance of Value Education and Service Learning and ways to promote peace and harmony	**L2, L3 & L4**
CO-5	Recognize the core human values for shaping an individual's personality, external behavior and internal sense of wellbeing	**L1 & L2**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Indian Ethos and Modern Management (IEMM-402)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	3	2	2	2	2	0	0	0	0	2
CO-2	2	3	2	3	3	1	1	0	0	0	0	2

CO-3	3	3	3	3	2	2	2	0	1	0	0	1
CO-4	3	3	3	2	2	2	2	0	0	0	0	1
CO-5	3	3	2	2	2	2	2	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech.(AI-ML)**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: OOPs**
Course Code: RDCS-241	**Title: OOPs**

Course Objectives:

1. Provide flexible and powerful abstraction.
2. Allow programmers to think the problem in terms of the structure rather than in terms of structure of the computer.
3. Decompose the problem into a set of objects.
4. Objects interact with each other to solve the problem.
5. Create new type of objects to model elements from the problem space.

Nature of Paper: DSE (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Principles of Object Oriented Programming** Procedure Oriented Programming (POP) verses Object Oriented Programming (OOP), Features of Object Oriented Programming, Examples of Object Oriented languages, Applications of OOP, Data types, Declaration of variable, Dynamic initialization of variable, Reference variable, Type casting, Basics of object and class in C++, Private and public members, static data and function members **Special Operators in C++:** Scope resolution operator, Memory management operators, Manipulators, Structure of C++ program, Basic Input /Output operators and functions in C++, Simple C++ Program **Class & Object:** Introduction, Specifying a class, Access specifiers, Defining member functions: Inside class and Outside class, Creating objects, Memory allocations for object	9L
II	**Functions and Constructors:** Inline function, Static data members, Static member function, Friend function: Using two different classes , Using non-member function ,Array of Objects, Object as function arguments, Concepts of Constructors, Types of constructors, Constructor overloading and Constructors with default arguments , Destructors	9L

III	**Extending classes using Inheritance**: Introduction to Inheritance, Defining a derived class, Visibility modes and effects, Types of Inheritance : Single, Multilevel, Multiple, Hierarchical, Hybrid, Virtual base class, Abstract class, Constructor in derived class	**9L**
IV	**Pointers and Polymorphism in C++**: **Concept of Pointer:** Pointer declaration, Pointer operator, Address operator, Pointer arithmetic , Pointer to Object: Pointer to object, 'this' pointer, Pointer to derived class, Introduction of Polymorphism, Types of polymorphism, Compile time Polymorphism: Function overloading, Revision of constructor overloading, Operator overloading: Rules for operator overloading, Overloading of unary and binary operators, Run time polymorphism: Virtual function, Rules for virtual function, Pure virtual function	**9L**
V	**File operations**: C++ stream classes, Classes for file stream operations, Detection of end of file, File modes, Opening files: Using constructors and open(), Closing files, Reading from and writing to files, Formatted Input/output functions in file, Types of file: Random access, Sequential access	**9L**

Text Books:

1. Object Oriented Programming with C++ by E. Balagurusamy, McGraw-Hill Education (India).
2. ANSI and Turbo C++ by Ashoke N. Kamthane, Pearson Education

Reference Books:

1. C++ and Object Oriented Programming – Jana, PHI Learning.
2. Mastering C++ - Venugopal, McGraw-Hill Education (India).

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Recognize features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity.	**L2**
CO-2	Apply some common object-oriented design patterns.	**L3**
CO-3	Specify simple abstract data types and design implementations using abstraction functions to document them.	**L2 & L3**
CO-4	Design a convenient way for the handling problems using templates and use simple try-catch blocks for Exception Handling.	**L2 &L3**
CO-5	Manage I/O streams and File I/O oriented interactions.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
OOPs (RDCS-241)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	2	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech(AI-ML)**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Data Analytics**
Course Code: RDCS-242	**Title: Data Analytics**

Course Objectives:

- Student will be able to describe the life cycle phases of Data Analytics through discovery, planning and building.
- Student will be able to understand and apply Data Analysis Techniques.
- Student will be able to implement various Data streams
- Student will be able to understand item sets, Clustering, frame works & Visualizations.

Student will be able to apply R tool for developing and evaluating real time applications

Nature of Paper: Discipline Specific Electives

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Data Analytics:** Sources and nature of data, classification of data, characteristics of data, introduction to Big Data platform, need of data analytics, evolution of analytic scalability, analytic process and tools, analysis vs reporting, modern data analytic tools, applications of data analytics. Data Analytics Lifecycle: Need, key roles for successful analytic projects, various phases of data analytics lifecycle – discovery, data preparation, model planning, model building, communicating results, and operationalization.	9
II	**Data Analysis:** Regression modeling, multivariate analysis, Bayesian modeling, inference and Bayesian networks, support vector and kernel methods, analysis of time series: linear systems analysis & nonlinear dynamics, rule induction, neural networks: learning and generalisation, competitive learning, principal component analysis and neural networks, fuzzy logic: extracting fuzzy models from data, fuzzy decision trees, stochastic search methods.	9
III	**Mining Data Streams:** Introduction to streams concepts, stream data model and architecture, stream computing, sampling data in a stream, filtering streams, counting distinct elements in a stream, estimating moments, counting oneness in a window, decaying window, Real-time Analytics Platform (RTAP) applications, Case studies – real time sentiment analysis, stock market predictions	9

IV	**Frequent Itemsets and Clustering:** Mining frequent itemsets, market based modelling, Apriori algorithm, handling large data sets in main memory, limited pass algorithm, counting frequent itemsets in a stream, clustering techniques: hierarchical, K-means, clustering high dimensional data, CLIQUE and ProCLUS, frequent pattern based clustering methods, clustering in non-euclidean space, clustering for streams and parallelism.	9
V	**Frame Works and Visualization:** MapReduce, Hadoop, Pig, Hive, HBase, MapR, Sharding, NoSQL Databases, S3, Hadoop Distributed File Systems, Visualization: visual data analysis techniques, interaction techniques, systems and applications. Introduction to R - R graphical user interfaces, data import and export, attribute and data types, descriptive statistics, exploratory data analysis, visualization before analysis, analytics for unstructured data.	9

Reference / Text Books:

Text books:

1. Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer
2. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press

Reference Books:

1. Bill Franks, Taming the Big Data Tidal wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, John Wiley & Sons.
2. John Garrett, Data Analytics for IT Networks: Developing Innovative Use Cases, Pearson Education
3. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Describe the life cycle phases of Data Analytics through discovery, planning and building.	
CO-2	Understand and apply Data Analysis Techniques.	
CO-3	Implement various Data streams.	
CO-4	Understand item sets, Clustering, frame works & Visualizations.	
CO-5	Apply R tool for developing and evaluating real time applications.	

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Data Analytics (RDCS-242)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	3	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	2	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech(AI-ML)**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Pratical: 0**	**Subject: Distributed System**
Course Code: RDCS-243	**Title: Distributed System**

Course Objectives:

1. **Understand the fundamentals** of distributed systems, including architectural models, communication, processes, naming, synchronization, and consistency.
2. **Explore the design principles** and implementation techniques of distributed systems such as client-server models, peer-to-peer systems, and cloud computing platforms.
3. **Familiarize students with resource management**, including load balancing, scheduling, and replication techniques in a distributed environment.
4. **Understand real-world applications** of distributed systems such as distributed databases, distributed file systems, and distributed object-based middleware.

Nature of Paper: Discipline Specific Electives

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Distributed Environment:** Introduction, Limitations, Remote Procedure Call, Remote Object Invocation, Message-Oriented Communication, Unicasting, Multicasting and Broadcasting, Group Communication.	8
II	**Distributed Operating Systems:** Issues in Distributed Operating Systems, Threads in Distributed Systems, Clock Synchronization, Causal Ordering, Global States, Election Algorithms, Distributed Mutual Exclusion, Distributed Deadlock, Agreement Protocols	8
III	**Distributed Resource Management:** Distributed Shared Memory, Data-Centric Consistency Models, Client-Centric Consistency Models, Distributed File Systems, Sun NFS.	8
IV	**Distributed Transaction Processing:** Transactions, Nested Transactions, Locks, Optimistic Concurrency Control, Timestamp Ordering, Comparison, Flat and Nested Distributed Transactions, Atomic Commit Protocols, Concurrency Control in Distributed Transactions, Distributed Deadlocks, Transaction Recovery, Overview of Replication and Distributed Multimedia Systems.	8
V	**Fault Tolerance and Consensus:** Introduction to Fault Tolerance, Distributed Commit Protocols, Byzantine Fault Tolerance, Impossibilities	8

	in Fault Tolerance.	

Text Books:

1. Distributed Systems, Concepts and Design, George Coulouris, J Dollimore and Tim Kindberg, Pearson Education, 4th Edition, 2009.

Reference Books:

1. Distributed Systems, Principles and Paradigms, Andrew S. Tanenbaum, Maarten Van Steen, 2nd Edition, PHI.
2. Distributed Systems, An Algorithm Approach, Sukumar Ghosh, Chapman & Hall/CRC, Taylor & Fransis Group, 2007.

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To understand what and why a distributed system	**L4**
CO-2	To understand theoretical concepts, namely, virtual time, agreement and consensus protocols.	**L1, L3**
CO-3	To understand IPC, Group Communication & RPC Concepts.	**L2**
CO-4	To understand the DFS and DSM Concepts.	**L4**
CO-5	To understand the concepts of transaction in distributed environment and associated concepts, namely, concurrency control, deadlocks and error recovery.	**L5**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Distributed System (RDCS-243)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	3	2	2	2	1	0	0	0	0	2	2
CO-2	2	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	3	2	3	1	0	0	0	0	0	1	2
CO-4	2	3	2	3	2	1	0	0	0	0	1	1
CO-5	2	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech (AI-ML)**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Computer Graphics**
Course Code: RDCS-244	**Title: Computer Graphics**

Course Objectives:

- Student will be able to understand the graphics hardware used in field of computer graphics.
- Student will be able to understand the concept of graphics primitives such as lines and circle based on different algorithms.
- Student will be able to apply the 2D graphics transformations, composite transformation and Clipping concepts.
- Student will be able to apply the concepts of and techniques used in 3D computer graphics, including viewing transformations.
- Student will be able to perform the concept of projections, curve and hidden surfaces in real life.

Nature of Paper: Discipline Specific Electives

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction and Line Generation:** Types of computer graphics, Graphic Displays- Random scan displays, Raster scan displays, Frame buffer and video controller, Points and lines, Line drawing algorithms, Circle generating algorithms, Mid-point circle generating algorithm, and parallel version of these algorithms.	8
II	**Transformations:** Basic transformation, Matrix representations and homogenous coordinates, Composite transformations, Reflections and shearing. Windowing and Clipping: Viewing pipeline, Viewing transformations, 2-D Clipping algorithms Line clipping algorithms such as Cohen Sutherland line clipping algorithm, Liang Bar sky algorithm, Line clipping against non rectangular clip windows; Polygon clipping – Sutherland Hodgeman polygon clipping, Weiler and Atherton polygon clipping, Curve clipping, Text clipping	8
III	**Three Dimensional:** 3-D Geometric Primitives, 3-D Object representation, 3-D Transformation, 3- D viewing, projections, 3-D Clipping.	8
IV	**Curves and Surfaces:** Quadric surfaces, Spheres, Ellipsoid, Blobby objects, Introductory concepts of Spline, Bspline and Bezier curves and surfaces.	8
V	**Hidden Lines and Surfaces:** Back Face Detection algorithm, Depth	

	buffer method, A- buffer method, Scan line method, basic illumination models– Ambient light, Diffuse reflection, Specular reflection and Phong model, Combined approach, Warn model, Intensity Attenuation, Color consideration, Transparency and Shadows.	8

Text books:

1. Donald Hearn and M Pauline Baker, "Computer Graphics C Version", Pearson Education
2. Foley, Vandam, Feiner, Hughes – "Computer Graphics principle", Pearson Education

Reference Books:

1. Rogers, " Procedural Elements of Computer Graphics", McGraw Hill
2. W. M. Newman, R. F. Sproull – "Principles of Interactive computer Graphics" – McGraw Hill.
3. Amrendra N Sinha and Arun D Udai," Computer Graphics", McGraw Hill.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the graphics hardware used in field of computer graphics.	
CO-2	Understand the concept of graphics primitives such as lines and circle based on different algorithms.	
CO-3	Apply the 2D graphics transformations, composite transformation and Clipping concepts.	
CO-4	Apply the concepts of and techniques used in 3D computer graphics, including viewing transformations.	
CO-5	Perform the concept of projections, curve and hidden surfaces in real life.	

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Computer Graphics (RDCS-244)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	3	2	1	0	0	0	0	2	1
CO-2	2	3	2	3	1	1	0	0	0	0	1	2
CO-3	2	3	2	3	2	0	0	0	0	0	1	1
CO-4	3	2	2	3	2	1	0	0	0	0	1	2
CO-5	2	3	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech. (AI-ML)**	**Year: II** **Semester: IV**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Machine Learning and Pattern Recognition Lab**
Course Code: RTAI -241P	**Title: Machine Learning and Pattern Recognition Lab**

Course Objectives:
1. To introduce the fundamental concepts and types of machine learning.
2. To explain key theoretical aspects like model complexity, overfitting, and bias-variance trade-off.
3. To develop understanding of linear regression techniques and their applications.
4. To explore classification algorithms including logistic regression and discriminant analysis.
5. To prepare students for applying machine learning models to real-world problems.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 3	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	**Introduction to Machine Learning Concepts:** Write a Python program to load a sample dataset (e.g., Iris or Titanic), identify variable types (categorical, numerical), and explore key ML terminology such as features, target, model, and prediction using comments and outputs.
Practical-2.	**Supervised vs Unsupervised Learning:** Use scikit-learn to apply both supervised (e.g., linear regression) and unsupervised (e.g., KMeans clustering) models on a small dataset. Compare how the two approaches behave and visualize their outputs.
Practical-3.	**Linear Regression Implementation:** Implement simple linear regression using scikit-learn. Train the model on a dataset (e.g., student scores vs hours studied), visualize the regression line, and interpret the coefficients.
Practical-4.	**Multiple Linear Regression:** Use a dataset with multiple independent variables (e.g., house prices with features like area, bedrooms, and location) to build a multiple linear regression model. Evaluate performance using R^2 and RMSE.
Practical-5.	**Evaluating Model Accuracy (Regression):** Perform train-test split and calculate evaluation metrics like Mean Absolute Error (MAE), Mean Squared Error (MSE), and R^2 score for regression models. Use plots to show residual errors.
Practical-6.	**Bias-Variance Tradeoff Simulation:** Create an example where you train models with varying complexity (e.g., polynomial regression of different degrees). Plot training and validation errors to illustrate underfitting, overfitting, and the trade-off.
Practical-7.	**Logistic Regression (Binary Classification):** Train a logistic regression model on a binary dataset (e.g., predicting pass/fail based on study hours). Plot decision boundaries and calculate accuracy, precision, recall, and confusion matrix.
Practical-8.	**Multiclass Logistic Regression:** Use the Iris dataset to build and evaluate a multiclass logistic regression model. Display classification report and confusion matrix, and

	visualize decision boundaries using 2D feature projections.
Practical-9.	**Linear Discriminant Analysis (LDA):** Apply LDA for dimensionality reduction and classification using the Iris dataset. Compare its performance with logistic regression and visualize class separation.
Practical-10.	**Quadratic Discriminant Analysis (QDA):** Implement QDA on a dataset with non-linear class boundaries. Visualize decision regions and discuss the difference in assumptions and outcomes compared to LDA.

Reference / Text Books:

1. *An Introduction to Statistical Learning – Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, 2nd Edition, Springer.*
2. *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow – Aurélien Géron, 2nd Edition, O'Reilly Media.*
3. *Machine Learning – Tom M. Mitchell, 1st Edition, McGraw-Hill.*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Understand the basic principles, types, and real-world applications of machine learning.	**L3**
CO-2	Explain key machine learning concepts such as model selection, overfitting, and the bias-variance trade-off.	**L3**
CO-3	Apply linear regression models to predict continuous outcomes and interpret coefficients.	**L3**
CO-4	Implement and analyze logistic regression for classification problems.	**L3 & L4**
CO-5	Utilize advanced classification techniques like LDA and QDA for high-dimensional data.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Machine Learning and Pattern Recognition Lab (RTAI -241P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	1	0	0	0	1	2	3
CO-2	3	3	3	2	1	1	0	0	0	1	1	3
CO-3	3	3	3	3	1	0	0	0	0	0	1	3
CO-4	3	3	3	2	1	1	0	0	0	1	2	3
CO-5	3	3	3	3	2	1	0	0	0	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech. (AI-ML)**	**Year: II** **Semester: IV**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: AI Product Development and Deployment Lab**
Course Code: RTAI -242P	**Title: AI Product Development and Deployment Lab**

Course Objectives:

1. To understand the process of AI prototyping, stakeholder alignment, and ethical AI practices.
2. To gain knowledge of model optimization, packaging, and ensuring reproducibility in AI systems.
3. To explore scalable deployment architectures, containerization, and cloud-edge integration.
4. To develop monitoring and CI/CD workflows for maintaining AI systems in production.
5. To evaluate business integration, AI ROI, and strategies for successful AI project implementation.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 3	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1	**Stakeholder Requirement Document & Feasibility Report** Create a stakeholder alignment document for an AI solution (e.g., customer churn prediction), including business goals, technical feasibility, KPIs, and ethical concerns.
Practical-2	**Rapid Prototyping with Jupyter Notebook and Streamlit** Use a basic dataset (like Iris or Titanic) and develop a rapid ML prototype in a Jupyter notebook. Then convert it to a Streamlit web app for interactive usage.
Practical-3	**Synthetic Data Generation Using Faker or Gretel.ai** Generate synthetic data using the Faker library or Gretel.ai APIs for a customer profile dataset. Visualize and validate the realism of generated data.
Practical-4	**Model Experimentation with MLflow** Train multiple versions of a model (e.g., logistic regression, random forest). Use MLflow to log parameters, metrics, and artifacts to compare models.
Practical-5	**Bias Detection and Mitigation Using Fairlearn or Aequitas** Train a model with biased data (e.g., gender bias in hiring). Use Fairlearn or Aequitas to measure fairness and apply mitigation techniques like equalized odds.
Practical-6	**Model Optimization: Pruning and Quantization** Optimize a pre-trained model using pruning and quantization techniques. Use PyTorch or TensorFlow Lite to demonstrate model size and performance improvement.
Practical-7	**Package and Reproduce an AI Model with Docker & MLflow** Package a trained model using MLflow, define conda.yaml or requirements.txt, and containerize it using Docker. Validate reproducibility on another system.
Practical-8	**REST API for Model Serving using FastAPI** Build a FastAPI service to serve a trained ML model. Deploy it locally and test using tools like Postman or curl. Return predictions via POST requests.

Practical-9	**Kubernetes Deployment: Docker Compose to K8s** Deploy the above FastAPI Docker container on Kubernetes. Write YAML files to define pod, deployment, and service. Use Minikube or GKE for testing.
Practical-10	**Monitoring ML Model with Prometheus & Grafana** Integrate Prometheus to log metrics like model inference time. Use Grafana dashboards to visualize metrics and set alerts for model drift or errors.

Reference / Text Books:

1. *Designing Machine Learning Systems with Python* – David Julian, 1st Edition, O'Reilly Media.
2. *Machine Learning Engineering* – Andriy Burkov, 1st Edition, True Positive Inc.
3. *Building Machine Learning Powered Applications* – Emmanuel Ameisen, 1st Edition, O'Reilly Media.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Define and align AI problem statements with business and stakeholder requirements, and create rapid prototypes.	**L3**
CO-2	Optimize models and package them using modern tools like MLflow, Docker, and ONNX for reproducibility.	**L3**
CO-3	Design deployment strategies using REST APIs, Kubernetes, and compare cloud vs edge deployments.	**L3**
CO-4	Implement monitoring, alerting, and CI/CD pipelines using tools like Prometheus, Grafana, and Apache Airflow.	**L3 & L4**
CO-5	Analyze the success of AI integration into business systems and measure return on investment through KPIs.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
AI Product Development and Deployment Lab(RTAI -242P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	1	0	0	0	1	2	3
CO-2	3	3	3	2	1	1	0	0	0	1	1	3
CO-3	3	3	3	3	1	0	0	0	0	0	1	3
CO-4	3	3	3	2	1	1	0	0	0	1	2	3
CO-5	3	3	3	3	2	1	0	0	0	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech (AI-ML)**	**Year: III** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Cloud Computing**
Course Code: RDCS-364	**Title: Cloud Computing**

Course Objectives:

1. Understand the basic principles of cloud computing.
2. To study the basic technologies that forms the foundations of Big Data.
3. To study the programming aspects of cloud computing with a view to rapid prototyping of complex applications.
4. To understand the specialized aspects of big data including big data application, and big data analytics.
5. To study different types Case studies on the current research and applications of the Hadoop and big data in industry

Nature of Paper: DSE (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Overview of Cloud Computing, history, definition and evolution, Underlying concept of Parallel and Distributed computing, Cloud Architecture, and its types. Business models built around cloud technology, Case studies of major players in Cloud Computing. Overview of Cloud Services, Software as a Service Platform, Infrastructure as a Service, Database as a Service, Monitoring as a Service, communication as services.	9L
II	Introduction to Simulator, understanding CloudSim simulator, Cloud Sim Architecture (User code, CloudSim, Grid Sim, SimJava) Understanding Working platform for Cloud Sim, Introduction to Green Cloud. Discussion of issues in Clouds, Eucalyptus, Nimbus, Open Nebula, and Cloud Sim. Discussion of service providers such as Google, Amazon, Microsoft Azure, IBM, Sales force.	9L
III	Collaborating Using Cloud Services such as Email Communication over the Cloud, Project Management, Calendar, Schedules, Word Processing, Presentation, Spreadsheet, Databases, Desktop, Social Networks, customer relationship management and Groupware.	9L
IV	Virtualization, Need, Pros and cons, Types of Virtualization in cloud, System and Process VM, Virtual Machine monitor, machine, Interpretation and binary translation, Overview of HLL VM supervisors, Xen, KVM, VMware, Virtual Box, Hyper-V.	9L

V	Security in Clouds and challenges, Software as a Service Security, Overview of Common Standards in cloud i.e The Open Cloud Consortium. The Distributed Management Task Force, Standards for application Developers, Standards for Messaging, Standards for Security, End user access to cloud computing, Discussion on Mobile Internet devices and the cloud. Overview of Hadoop, MapReduce, Virtual Box. Discussion on Google App Engine and Programming Environment for Google App Engine.	**9L**

Text Books:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, John W., and James F. Ransome,—Cloud Computing: Implementation, Management and Security, CRC Press, 2017.
3. RajkumarBuyya, Christian Vecchiola, S. Thamarai Selvi,—Mastering Cloud Computing, Tata Mcgraw Hill, 2013.

Reference Books:

1. *Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.*
2. *George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Theory of Formal Languages and Automata

Course Learning Outcomes:

CO-1	Student must be Able to understand the building blocks of Big Data	**L2 & L3**
CO-2	Student must be able to articulate the programming aspects of cloud computing(map Reduce etc)	**L3 &L4**
CO-3	Student must be able to understand the specialized aspects of big data with the help of different big data applications	**L1& L3**
CO-4	Student must be able to represent the analytical aspects of Big Data	**L2 & L3**
CO-5	Student must be know the recent research trends related to Hadoop File System, MapReduce and Google File System etc	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Cloud Computing (RDCS-364)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12

CO-1	2	1	2	2	2	1	0	1	0	2	2	2
CO-2	1	3	2	3	2	1	0	2	0	2	1	2
CO-3	2	2	0	1	1	0	0	1	0	3	1	2
CO-4	3	1	2	3	2	1	0	1	0	2	1	1
CO-5	2	2	2	2	2	1	0	3	0	3	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B.Tech (CSE-AIML)**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Design and Analysis of Algorithm**
Course Code: SECS-351	**Title: Design and Analysis of Algorithm**

Course Objectives:
The Student will Learn:

1. To analyze performance of algorithms & Understanding the growth of function.
2. To choose the appropriate data sorting algorithm for performing sorting in data structure.
3. To choose the appropriate data structure and algorithm design method for a specified application.
4. To solve problems using algorithm design methods such as the greedy method, divide and conquer, dynamic programming, backtracking and branch and bound.
5. To analyze performance of string matching and randomized algorithms. To introduce P and NP classes.

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Algorithms, Analyzing Algorithms, Complexity of Algorithms, Growth of Functions, Asymptotic Notations Performance Measurements, Recurrence Relation, Method of Solving recurrence function **Sorting and Order Statistics** – Shell Sort, Quick Sort, Merge Sort, Heap Sort, Comparison of Sorting Algorithms, Sorting in Linear Time.	**8L**
II	**Advanced Data Structures:** Red-Black Trees, B – Trees, Binomial Heaps, and Fibonacci Heaps.	**8L**
III	**Divide and Conquer:** Matrix Multiplication, Convex Hull and Searching. Longest Common Subsequence (LCS) Problem. **Greedy Methods**: Optimal Reliability Allocation, Knapsack, Minimum Spanning Trees – Prim's and Kruskal's Algorithms, Single Source Shortest Paths – Dijkstra's and Bellman Ford Algorithms.	**8L**
IV	**Dynamic Programming:** Knapsack, All Pair Shortest Paths – Warshal's and Floyd's Algorithms, Resource Allocation Problem. **Branch and Bound:** Travelling Salesman Problem, **Backtracking:** Graph Coloring, n-Queen Problem, Hamiltonian Cycles and Sum of Subsets.	**8L**
V	**String Matching:** Algorithm for string matching, Theory of NP-Completeness, Approximation Algorithms and Randomized Algorithms.	**8L**

Reference / Text Books:

1. Thomas H. Coreman, Charles E. Leiserson and Ronald L. Rivest, "Introduction to Algorithms", Printice Hall of India.
2. E. Horowitz & S Sahni, "Fundamentals of Computer Algorithms", 3. Aho, Hopcraft, Ullman, "The Design and Analysis of Computer Algorithms" Pearson Education, 2008.
3. LEE "Design & Analysis of Algorithms (POD)",McGraw Hill
4. Robert Sedgewick and Kevin Wayne, Algorithms, fourth edition, Addison Wesley, 2011.
5. Jon Kleinberg and Éva Tardos, Algorithm Design, Pearson, 2005.
6. Michael T Goodrich and Roberto Tamassia, Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Wiley, 2006.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course: Data Structures

Course Learning Outcomes:

After completing the course, students should be able to:

1. Design new algorithms, prove them correct, and analyze their asymptotic and absolute runtime and memory demands.
2. Find an algorithm to solve the problem (create) and prove that the algorithm solves the problem correctly (validate).
3. Understand the mathematical criterion for deciding whether an algorithm is efficient, and know many practically important problems that do not admit any efficient algorithms.
4. Apply classical sorting, searching, optimization and graph algorithms.
5. Understand basic techniques for designing algorithms, including the techniques of recursion, divide-and-conquer, and greedy.
6. Understand string matching algorithms, approximation algorithms and randomized algorithms.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: V

Programme: UG(R) **Class: B.Tech (CSE-AIML)**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Deep Learning Lab with Python, Tensor Flow and Keras**
Course Code: SEAIML-351	**Title: Deep Learning Lab with Python, Tensor Flow and Keras**

Course Objectives: The objective of this course is to teach students the basic concepts of neural networks, neurons, and deep learning.

Nature of Paper: Core Paper

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:4(In Hours/Week)

Unit	Contents	No. of Lectures Allotted
I	**Moving beyond gradient descent Models:** Local minima vs global minima vs saddle, model identifiability, correcting gradient points in wrong directions, Momentum based optimization.	**8**
II	**Second order:** methods, learning rate adaption, adagrad, rmsprop. **Convolution Neural Network implementation**: Convolution operation, filters and feature maps	**8**
III	**Motivation, sparse interactions:** parameter sharing and equivariant representation, padding and stride, max pooling, full architectural description of convolution network, build cnn using data augmentation, using pretrained convnet, visualize what convnet learn.	**8**
IV	**Embedding and Representation Learning analysis:** Principle component analysis, working with text data, one-hot encoding of words and characters, word embedding, autoencoder architecture, denoising, sparsity, Word2vec framework, Skip-Gram Architecture.	**8**
V	**Models for Sequence Analysis networks:** Analysing Variable-length inputs, Seq2seq with neural n-gram, part of speech tagger, dependency parse, syntaxnet, recurrent neural network, challenges with vanishing gradients, long short term memory units	**8**

Reference / Text Books:

1. Deep Learning with TensorFlow and Keras: Build and deploy supervised, unsupervised, deep, and reinforcement learning models Paperback – Import, 4 November 2022 by Amita Kapoor , Antonio Gullir, Sujit Pal, Francois Chollet.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	-

4) Research Project Report / Seminar On Research Project Report	20
5) ESE	100
Total:	**150**

Prerequisites for the course: Deep Learning Lab with Python, Tensor Flow and Keras basics

Course Learning Outcomes:

After completing the course, students should be able to:

1. Learn Neural Network, Feed Forward and Back propogation and implement them in neural networks.
2. Learn and implement various problem solutions using Tensorflow and Keras.
3. Learn and implement RNN, CNN, Auto encoders.
4. Learn and implement Models for Sequence Analysis networks.
5. Learn Convolution Neural Networks.
6. Learn Embedding and Representation Learning analysis and using them for problem solving.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: V

Programme: UG(R) **Class: B.Tech (CSE -AIML)**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Neural Networks and Deep Learning Computer Networks**
Course Code: SEAIML-352	**Title: Neural Networks and Deep Learning Computer Networks**

Course Objectives: The objective of this course is to teach students the basic concepts of neural networks, neurons, and deep learning.

Nature of Paper: Core Paper

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0 (In Hours/Week)

Unit	Contents	No. of Lectures Allotted
I	**The neural network neurons**: The neuron, linear perceptron, feed-forward neural network, limitations of linear neurons, sigmoid, tanh, relu neurons.	**8**
II	**Soft max output layer:** information theory, cross entropy, Kullback-Leibler divergence.Training feed-forward neural network: Gradient Descent, delta rules and learning rates,gradient descent with sigmoid neurons.	**8**
III	**The back propagation algorithms**: stochastic and mini batch gradient descent, test sets, validation sets and over fitting, preventing over fitting.	**8**
IV	**Tensor Flow: Computation graphs:** graphs, sessions and fetches, constructing and managing graph, flowing tensors, sessions, data types, tensor arrays and shapes, names, variables, placeholders and simple optimization, linear regression and logistic regression using tensor flow	**8**
V	**Implement Neural Network and keras:** Introduction to Keras, Build neural network using Keras, Evaluating models, data preprocessing, feature engineering, feature learning, over fitting.	**8**

Reference / Text Books:

1. Deep Learning with Python by Francois Chollet - Manning Publications; 1 edition, Deep Learning by Ian Goodfellow, Yoshua Bengio, Aaron Courville, Francis Bach – MIT Press (3 January 2017)

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course: Neural Networks and Deep Learning Computer Networks fundamentals

Course Learning Outcomes:

After completing the course, students should be able to:

1. Explain the concept of neural networks and neurons.
2. Explain the concept of Soft max output layer.
3. Learn the back propagation algorithms and use them to solve problems.
4. Learn and use Tensor flow.
5. Implement Neural Network
6. Learn and Implement keras.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: V

Programme: UG(R) **Class: B.Tech CSE(AIML)**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Discrete Structures & Theory of Logic**
Course Code: SDAIML-351	**Title: Discrete Structures & Theory of Logic**

Course Objectives:
The Student will Learn:

- To acquaint the concept of set theory, relations and functions.
- To understand the concepts related to algebraic structures.
- To introduce the fundamentals of Boolean algebra and its properties.
- To acquaint the concept of Propositional Logic and Predicate Logic
- To use concept of trees and graph theory for solving practical problems.

Nature of Paper: Department Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Set Theory: Introduction, Combination of sets, Multisets, Ordered pairs. Proofs of some general identities on sets. Relations: Definition, Operations on relations, Properties of relations, Composite Relations, Equality of relations, Recursive definition of relation, Order of relations. Functions: Definition, Classification of functions, Operations on functions, Recursively defined functions. Growth of Functions.	**8L**
II	Algebraic Structures: Definition, Groups, Subgroups and order, Cyclic Groups, Cosets, Lagrange's theorem, Normal Subgroups, Permutation and Symmetric groups, Group Homomorphisms, Definition and elementary properties of Rings and Fields.	**8L**
III	Lattices: Definition, Properties of lattices – Bounded, Complemented, Modular and Complete lattice. Boolean Algebra: Introduction, Axioms and Theorems of Boolean algebra, Algebraic manipulation of Boolean expressions. Simplification of Boolean Functions, Karnaugh maps, Logic gates, Digital circuits and Boolean algebra.	**8L**
IV	Propositional Logic: Proposition, well-formed formula, Truth tables, Tautology, Satisfiability, Contradiction, Algebra of proposition, Theory of Inference. Predicate Logic: First order predicate, well-formed formula of predicate, quantifiers, Inference theory of predicate logic	**8L**

V	Trees: Definition, Binary tree, Binary tree traversal, Binary search tree. Graphs: Definition and terminology, Representation of graphs, Multigraphs, Bipartite graphs, Planar graphs, Isomorphism and Homeomorphism of graphs, Euler and Hamiltonian paths, Graph coloring, Recurrence Relation & Generating function: Recursive definition of functions, Recursive algorithms, Method of solving recurrences. Combinatorics: Introduction, Counting Techniques, Pigeonhole Principle	**8L**

Reference / Text Books:

1. Hari Krishan, Discrete Mathematics, Pragati Edition
2. Lipchitz, S. & Lipson S., Discrete Mathematics, Outline series Tata McGraw Hill.
3. Kumar, S.S., Discrete Mathematics, S. Chand.
4. Dean, N., Essence of Discrete Mathematics, Prentice Hall Liu, C.L., Elements of Discrete Mathematics, McGraw Hill.
5. Rosen, Kenneth H., Discrete Mathematics and Its Applications, McGraw Hill.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course: Set Theory

Course Learning Outcomes:

After completing the course, students should be able to:

- To memorize and understand the concept of set theory, relation and function.
- To understand the fundamentals of algebraic structures
- To understand the fundamentals of Boolean algebra and illustrate their properties
- To understand the concept of Propositional Logic and Predicate Logic and illustrate their properties.
- To memorize and understand the concept of trees & graphs and exhibit their properties effectively.
- To memorize and understand the concept of Recurrence Relation, Generating function and Combinatorics.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B.Tech CSE(AIML)**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Database Management System**
Course Code: SDAIML-352	**Title: Database Management System**

Course Objectives:
The Student will Learn:

- To understand the basic concepts and the applications of database systems. To apply channel allocation, framing, error and flow control techniques.
- To master the basics of SQL and construct queries using SQL.
- To understand the relational database design principles and implementations.
- To understand the transaction processing
- To implement the concurrency techniques in transaction processing

Nature of Paper: Department Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Overview, Database System vs File System, Database System Concept and Architecture, Data Model Schema and Instances, Data Independence and Database Language and Interfaces, Data Definitions Language, DML, Overall Database Structure. Data Modeling Using the Entity Relationship Model: ER Model Concepts, Notation for ER Diagram, Mapping Constraints, Keys, Concepts of Super Key, Candidate Key, Primary Key, Generalization, Aggregation, Reduction of an ER Diagrams to Tables, Extended ER Model, Relationship of Higher Degree.	**8L**
II	Relational data Model and Language: Relational Data Model Concepts, Integrity Constraints, Entity Integrity, Referential Integrity, Keys Constraints, Domain Constraints, Relational Algebra, Relational Calculus, Tuple and Domain Calculus. Introduction on SQL: Characteristics of SQL, Advantage of SQL. SQL Data Type and Literals. Types of SQL Commands. SQL Operators and Their Procedure. Tables, Views and Indexes. Queries and Sub Queries. Aggregate Functions. Insert, Update and Delete Operations, Joins, Unions, Intersection, Minus, Cursors, Triggers, Procedures in SQL/PL SQL	**8L**
III	Data Base Design & Normalization: Functional dependencies, normal forms, first, second, 8 third normal forms, BCNF, inclusion	**8L**

	dependence, loss less join decompositions, normalization using FD, MVD, and JDs, alternative approaches to database design	
IV	Transaction Processing Concept: Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Checkpoints, Deadlock Handling. Distributed Database: Distributed Data Storage, Concurrency Control, Directory System.	**8L**
V	Concurrency Control Techniques: Concurrency Control, Locking Techniques for Concurrency Control, Time Stamping Protocols for Concurrency Control, Validation Based Protocol, Multiple Granularity, Multi Version Schemes, Recovery with Concurrent Transaction, Case Study of Oracle.	**8L**

Reference / Text Books:

1. "Data base System Concepts", A. Silberschatz, H.F. Korth, S.Sudarshan, McGraw Hill, VI edition
2. "Fundamental of Database systems " by Elsmasri &Navathe , 6th edition, Addison-Wesley.
3. "Data base Concepts" by CJ. Date, 7th edition.
4. "Database Management Concepts" by Raghu Ramakrishnan & Johannes Gehrke, 2nd edition.
5. Database Principles, Programming, and Performance, P.O'Neil, E.O'Neil, 2nd ed., ELSEVIER.
6. Database Management Systems, G.K. Gupta, TMH.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course: Nil

Course Learning Outcomes:

After completing the course, students should be able to:

- To memorize the basic concept of database systems and to understand the database modeling concept using ER modeling.
- To understand and apply the concept of relational data model and SQL for database management.
- To understand and apply the concept of normalization using FD, MVD & JD's for designing database effectively.
- To understand the Transaction processing fundamentals and transaction management.
- To understand the concept of deadlock and distributed database.
- To understand various protocols for maintaining concurrency in transactions of real world scenarios.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B.Tech CSE(AIML)**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Application of Soft Computing**
Course Code: SDAIML- 353	**Title: Application of Soft Computing**

Course Objectives:
The Student will Learn:
1. To introduce the concept of soft computing.
2. To acquaint the concept of Fuzzy System.
3. To understand the concepts of Neuro-fuzzy Modeling.
4. To introduce the concept of genetic algorithms.
5. To understand the applications of soft computing and to introduction MATLAB Environment.

Nature of Paper: Department Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to Soft Computing, ARTIFICIAL NEURAL NETWORKS Basic concepts - Single layer perception - Multilayer Perception - Supervised and Unsupervised learning – Back propagation networks - Kohnen's self-organizing networks - Hopfield network.	**8L**
II	FUZZY SYSTEMS Fuzzy sets, Fuzzy Relations and Fuzzy reasoning, Fuzzy functions - Decomposition - Fuzzy automata and languages - Fuzzy control methods - Fuzzy decision making.	**8L**
III	NEURO - FUZZY MODELING Adaptive networks based Fuzzy interface systems - Classification and Regression Trees - Data clustering algorithms - Rule based structure identification - Neuro-Fuzzy controls - Simulated annealing – Evolutionary computation	**8L**
IV	GENETIC ALGORITHMS Survival of the Fittest - Fitness Computations - Cross over - Mutation - Reproduction - Rank method - Rank space method	**8L**
V	APPLICATION OF SOFT COMPUTING Optimization of traveling salesman problem using Genetic Algorithm, Genetic algorithm based Internet Search Techniques, Soft computing based hybrid fuzzy controller, Introduction to MATLAB Environment for Soft computing Techniques.	**8L**

Reference / Text Books:
1. An Introduction to Genetic Algorithm Melanic Mitchell (MIT Press).

2. Evolutionary Algorithm for Solving Multi-objective, Optimization Problems (2nd Edition), Collelo, Lament, Veldhnizer (Springer).
3. Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley).
4. Neural Networks and Learning Machines Simon Haykin (PHI).
5. Sivanandam, Deepa, " Principles of Soft Computing", Wiley.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course: Fuzzy Logic

Course Learning Outcomes:

After completing the course, students should be able to:

1. To memorize and understand the concept of soft computing.
2. To understand the fundamentals of Fuzzy System.
3. To understand the fundamentals of Neuro-fuzzy Modeling
4. To understand the concept of genetic algorithms.
5. To understand the concept of genetic algorithm based Internet Search Techniques.
6. To memorize and understand the concept of applications of soft computing.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B.Tech (CSE-AIML)**	**Year: III** **Semester: V**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Augmented & Virtual Reality**
Course Code: SDAIML-354	**Title: Augmented & Virtual Reality**

Course Objectives:
The Student will Learn:

- To introduce the concept of Virtual reality and virtual environments.
- To acquaint the concept of 3D user interface input hardware.
- To understand the concepts of Software technologies and VR environment.
- To introduce the concept of 3D Interaction Techniques.
- To understand the applications of Augmented and Mixed Reality.

Nature of Paper: Department elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	VIRTUAL REALITY AND VIRTUAL ENVIRONMENTS: The historical development of VR: Scientific landmarks Computer Graphics, Real-time computer graphics, Flight simulation, Virtual environments, Requirements for VR, benefits of Virtual reality. HARDWARE TECHNOLOGIES FOR 3D USER INTERFACES: Visual Displays Auditory Displays, Haptic Displays, Choosing Output Devices for 3D User Interfaces	**8L**
II	3D USER INTERFACE INPUT HARDWARE: Input device characteristics, Desktop input devices, Tracking Devices, 3D Mice, Special Purpose Input Devices, Direct Human Input, Home - Brewed Input Devices, Choosing Input Devices for 3D Interfaces.	**8L**
III	SOFTWARE TECHNOLOGIES: Database - World Space, World Coordinate, World Environment, Objects - Geometry, Position / Orientation, Hierarchy, Bounding Volume, Scripts and other attributes, VR Environment - VR Database, Tessellated Data, LODs, Cullers and Occluders, Lights and Cameras, Scripts, Interaction - Simple, Feedback, Graphical User Interface, Control Panel, 2D Controls, Hardware Controls, Room / Stage / Area Descriptions, World Authoring and Playback, VR toolkits, Available software in the market	**8L**
IV	3D INTERACTION TECHNIQUES: 3D Manipulation tasks, Manipulation Techniques and Input Devices, Interaction Techniques for	**8L**

	3D Manipulation, Deign Guidelines - 3D Travel Tasks, Travel Techniques, Design Guidelines - Theoretical Foundations of Wayfinding, User Centered Wayfinding Support, Environment Centered Wayfinding Support, Evaluating Wayfinding Aids, Design Guidelines - System Control, Classification, Graphical Menus, Voice Commands, Gestrual Commands, Tools, Mutimodal System Control Techniques, Design Guidelines, Case Study: Mixing System Control Methods, Symbolic Input Tasks, symbolic Input Techniques, Design Guidelines, Beyond Text and Number entry . DESIGNING AND DEVELOPING 3D USER INTERFACES: Strategies for Designing and Developing Guidelines and Evaluation. VIRTUAL REALITY APPLICATIONS: Engineering, Architecture, Education, Medicine, Entertainment, Science, Training.	
V	Augmented and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems	**8L**

Reference / Text Books:

1. Alan B Craig, William R Sherman and Jeffrey D Will, "Developing Virtual Reality Applications: Foundations of Effective Design", Morgan Kaufmann, 2009.
2. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
3. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.
4. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005.
5. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, India, 2003.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course: Computer Graphics

Course Learning Outcomes:

After completing the course, students should be able to:

1. To memorize and understand the concept of Virtual reality and virtual environments.
2. To understand the fundamentals of 3D user interface input hardware.
3. To understand the fundamentals of Software technologies and VR environment.
4. To understand the concept of 3D Interaction Techniques.
5. To understand the concept of designing and developing 3D user interface and Virtual reality applications.
6. To memorize and understand the concept of Augmented and Mixed Reality.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class: B. Tech (CSE-AIML)**	**Year: III** **Semester: V**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Deep learning Lab with Python using Tensorflow and keras**
Course Code: SEAIML-351P	**Title: Deep learning Lab with Python using Tensorflow and keras**

Course Objectives:

- Help student understand what machine learning is. How business can use machine learning in different domains to gain competitive advantage
- Student is able to differentiate between different learning algorithms.
- Gain a fundamental understanding of the concepts and techniques that underpin machine learning algorithms
- Learn how to choose the appropriate regression and classification algorithms, how to prepare data for machine learning models, and how to evaluate model performance

Nature of Paper: Engineering Courses (Core)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits

L:3
T:1
P:3(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Name of the Practical	No. of Lectures Allotted for practical
I	To determine the implementation, installation and use of tensorflow and keras libraries with python	**2**
II	To determine the tensorflow estimators encapsulate training, evaluation, prediction, and exporting for your model.	**2**
III	To determine how to prepare a dataset and also to feed it to machine learning model.	**2**
IV	To build a simple Tensor Flow estimator for a multiple regression problem.	**2**
V	To build a regression model using a real dataset, the Boston Housing Price data set.	**2**
VI	To build a Classification model using a real dataset, the Titanic data set.	**2**
VII	To predict fuel efficiency in miles per gallon for the late 1970s and early 1980s automobiles.	**2**
VIII	To recognize the handwritten digits	**2**
IX	To recognize whether it's a dog or a cat using CNN	**2**
X	To implement a convolutional neural network.	**2**

Reference / Text Books:

1. Deep Learning with TensorFlow and Keras: Build and deploy supervised, unsupervised, deep, and reinforcement learning models Paperback – Import, 4 November 2022 by Amita Kapoor , Antonio Gulli , Sujit Pal , Francois Chollet.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Practical Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report / Seminar On Research Project Report	20
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

After completion of the course students would be able to :

1. Explain the use of Machine Learning Models in business and understand machine learning models can be used to solve business problems
2. Compare machine learning algorithms such as supervised, unsupervised, and reinforcement learning models
3. Identify the performance of different machine learning models and compare them to optimize the results
4. Make use continuous and discrete data set to fit regression and classification models.
5. Implementation of CNN.
6. To recognize whether it's a dog or a cat using CNN.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG(R) **Class:B.Tech (CSE-AIML)**	**Year: III** **Semester: V**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Neural Networks and Deep Learning Computer Network Lab**
Course Code: SEAIML-352P	**Title: Neural Networks and Deep Learning Computer network Lab**

Course Objectives:

- Students will be able to identify the deep learning algorithms which are more appropriate for various types of problems or learning tasks in various domains.
- Students will be able to Implement deep learning algorithms and solve real-world problems.
- This will help students in developing skills required to gain experience of doing independent research and study in the field of AI.
- Students will be able to build, train and apply CNN or RNN and fully connected deep neural networks

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 2 Credits

L:0
T:0
P:3(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Name of the Practical	No. of Lectures Allotted for practical
I	Set up a development environment and implement tensorflow version 1 and tensorflow version 2 operations.	**2**
II	Build simple Neural Network using TensorFlow and keras	**2**
III	Implementation of neural network and addressing the learning problem using python and tensorflow	**2**
IV	Implementation of estimator, Pipeline	**2**
V	Training simple neural network	**2**
VI	Implementation of RNN DL Model	**2**
VII	Implementing of CNN DL Model	**2**
VIII	Project:-Linear Regression - Predict Price of the House	**2**
IX	Project:-Classification - Predict survival from a Ship Passengers	**2**

Reference / Text Books:

Text books:

1. Goodfellow, I., Bengio,Y., and Courville, A., Deep Learning, MIT Press, 2016.
2. Python Deep Learning by Daniel Slater.

Reference Books:

1. Yegnanarayana, B., Artificial Neural Networks PHI Learning Pvt. Ltd, 2009.

2. Golub, G.,H., and Van Loan,C.,F., Matrix Computations, JHU Press,2013.
3. Satish Kumar, Neural Networks: A Classroom Approach, Tata McGraw-Hill Education, 2004.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Practical Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	30
Total:	**50**

Prerequisites for the course:

Course Learning Outcomes:

- Students will be able to identify the deep learning algorithms which are more appropriate for various types of problems or learning tasks in various domains.
- Students will be able to Implement deep learning algorithms and solve real-world problems.
- This will help students in developing skills required to gain experience of doing independent research and study in the field of AI.
- Students will be able to build, train and apply CNN or RNN and fully connected deep neural networks.
- Student will be able to implementation of RNN DL Model.
- Student will be able to Implementing of CNN DL Model.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

Programme: UG **Class: B.Tech-CSE(AIML)**	**Year: III** **Semester: V**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Design Analysis and Algorithm lab**
Course Code: SECS-351P	**Title: Design Analysis and Algorithm lab**

Course Objectives:

1. The principle objective of this course is to build solid foundation in algorithms and their applications.
2. To implement various divide and conquer techniques examples.
3. To implement various Greedy techniques examples.
4. To implement various Dynamic Programming techniques examples.
5. To provide a practical exposure of all algorithms.
6. To understand the importance of algorithm and its complexities

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 2 Credits

L:0
T:0
P:3(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Write a program to perform operation count for a given pseudo code	2
II	Write a program to perform Bubble sort for any given list of numbers.	2
III	Write a program to perform Insertion sort for any given list of numbers.	2
IV	Write a program to perform Quick Sort for the given list of integer values.	2
V	Write a program to find Maximum and Minimum of the given set of integer values.	2
VI	Write a Program to perform Merge Sort on the given two lists of integer values.	2
VII	Write a Program to perform Binary Search for a given set of integer values recursively and nonrecursively.	2
VIII	Write a program to find solution for knapsack problem using greedy method.	2
IX	Write a program to find minimum cost spanning tree using Prim's Algorithm.	2
X	Write a program to find minimum cost spanning tree using Kruskal's Algorithm	2

Reference / Text Books:

1. Thomas H. Coreman, Charles E. Leiserson and Ronald L. Rivest, "Introduction to Algorithms",

Printice Hall of India. 2. E. Horowitz & S Sahni, "Fundamentals of Computer Algorithms".	
If the course is available as Generic Elective then the students of following departments may opt it.1.	
Evaluation/Assessment Methodology	
	Max. Marks:50
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	30
Total:	**50**

Course Learning Outcomes:

Student will be able to :

1. To learn the importance of designing an algorithm in an effective way by considering space and time complexity
2. To learn divide and conquer strategy based algorithms
3. To learn greedy method based algorithms
4. To learn the dynamic programming design techniques
5. To develop Recursive backtracking algorithms
6. To learn graph search and network flow algorithms

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B.Tech (CSE-AIML)**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Data Science - Tools and Techniques**
Course Code: SEAIML-361	**Title: Data Science - Tools and Techniques**
Course Objectives: The student learns the architecture of HDFS and MapReduce along with other tools such as pig, hive, spark, Zookeeper, HBase.	
Nature of Paper: Core Paper	
Minimum Passing Marks/Credits: 40% Marks / 4 Credits	
L:3 T:1 P:0 (In Hours/Week)	

Unit	Contents	No. of lectures Allotted
I	**Big Data fundamentals:** Fundamentals of Big Data, defining big data, building successful big data management architecture, big data journey **Big Data Types and structured:** Structured and unstructured data types, real time and non-real time requirements	**8**
II	**Distributed Computing Basics:** History of distributed computing, basics of distributed computing **Big Data Technology Foundation and infrastructure:** Big Data stack, redundant physical infrastructure, security infrastructure, operational databases, organising data services and tools, analytical data warehouse, big data analytics **Virtualization:** Basics of virtualization, hypervisor, abstraction and virtualization, implementing virtualization with big data **Cloud and Big Data:** Defining cloud, cloud deployment and delivery models, cloud as an imperative for big data, use the cloud for big data	**8**
III	**Operational Databases:** Relational database, nonrelational database, key-value pair databases, document databases, columnar databases, graph databases, spatial databases. **MapReduce Fundamentals:** Origin of Map Reduce, map function, reduce function, putting map and reduce together, optimizing map reduce **Hadoop map reduce:** Discovering Hadoop, Hadoop distributed file system, Hadoop MapReduce, Hadoop file system, dataflow, Hadoop I/O, data integrity, compression, serialization, file-based data structure	**8**
IV	**Avro:** Avro data types and schemas, in-memory serialization and de-serialization, avro data files, schema resolution **Pig:** Comparison with databases, pig latin, user defined functions, data processing Operators	**8**
V	**Hive:** Running hive, comparison with traditional databases, HiveQL, tables, querying data, user- defined functions.	**8**

	Spark: Resilient distributed datasets, shared variables, anatomy of a spark job run, executors and cluster managers. **HBase:** HBasics, concepts, clients, HBase vs RDBMS, Praxis **ZooKeeper:** ZooKeeper services, building application with ZooKeeper	

Reference / Text Books:

1. Hadoop: The Definitive Guide, 4th Edition by Tom White - Shroff Publishers & Distributers Private Limited - Mumbai; Fourth edition (2015)
2. Big Data: Principles and Best Practices of Scalable Real-time Data Systems by James Warren and Nathan Marz, Manning Publications (2015)

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report / Seminar On Research Project Report	20
5) ESE	100
Total:	**150**

Prerequisites for the course: Data Science - Tools and Techniques fundamentals

Course Learning Outcomes:

After completing the course, students should be able to:

On completion of this course, the student will be able to

1. Explain the concept of Big Data, its structures and its types.
2. Explain the concepts of distributed computing, big data and cloud data virtualization.
3. Explain the concept of MapReduce and Hadoop map reduce.
4. To find solution of big data problems using Big data tools such as Pig and avro.
5. Learn Big data tools such as hive.
6. Learn Big data tools such as Zookeeper and HBase.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B.Tech CSE(AIML)**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Natural Language Processing**
Course Code: SEAIML-362	**Title: Natural Language Processing**
Course Objectives: The ultimate objective of NLP is to read, decipher, understand, and make sense of the human languages in a manner that is valuable.	
Nature of Paper: CORE Paper	
Minimum Passing Marks/Credits: 40% Marks / 4 Credits	
L:3 T:1 P:0 (In Hours/Week)	

Unit	Contents	No. of Lectures Allotted
I	**Introduction to NLP Language:** Natural Language Processing in real world, What is language, Approached to NLP. **Build NLP model:** Eights Steps for building NLP Model, Web Scrapping	**8**
II	**Text Representation:** Basic Vectorization, One-Hot Encoding, Bag of Words, Bag of N Grams, TF-IDF, Pertained Word Embedding, Custom Word Embeddings, Vector Representations via averaging, Doc2Vec Model,Visualizing Embeddings using TSNW and Tensorboard.	**8**
III	**Text Classification and SVM:** Application of Text Classification, Steps for building text classification system, Text classification using Naïve Bayes Classifier, Logistic Regression, and Support Vector Machine, Neural embedding for Text Classification, text classification using deep learning, interpret text classification model.	**8**
IV	**Information Extraction Entity:** Applications of Information Extraction, Processes for Information Extraction. Key phrase Extraction, Named Entity Recognition, Disambiguation and linking of named entity, Relationship extraction **Chatbot:** Real life applications of chatbot, Chatbot Taxonomy, Dialog Systems, Process of building a dialog, Components of Dialog System, End to End Approach, Rasa NLU,	**8**
V	**NLP for social media:** Application of NLP in social media, challenges with social media, Natural Language Processing for Social Data, Understanding Twitter Sentiments, Identifying memes and Fake News **NLP for E-Commerce**: E-commerce catalog, Search in E-Commerce, How to build an e-commerce catalog, Review and Sentiment Analysis, Recommendations for E-Commerce.	**8**

Reference / Text Books:

1. Natural Language Processing with Python by Steven Bird, Ewan Klein and Edward Loper.
2. Foundations of Statistical Natural Language Processing by Christopher Manning and Hinrich

Schütze.	
Evaluation/Assessment Methodology	
	Max. Marks:100
1) Class tasks/ Sessional Examination 2) Presentations /Seminar 3) Assignments 4) Research Project Report / Seminar On Research Project Report 5) ESE	50 - - - 100
Total:	**150**
Prerequisites for the course: Natural Language Processing basics.	

Course Learning Outcomes:

After completing the course, students should be able to:

1. Define NLP, to resolve ambiguity in language and can build NLP models.
2. To represent the text in different models.
3. Classify the text using support vector machine.
4. Extract information using different methods.
5. Develop chatbot applications.
6. Use NLP in e-commerce and social media.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme:UG(R) **Class: B.Tech CSE(AIML)**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Computer Networks**
Course Code: SDAIML-361	**Title: Computer Networks**

Course Objectives:
The Student will Learn:

- To explain basic concepts, OSI reference model, services and role of each layer of OSI model and TCP/IP, networks devices and transmission media, Analog and digital data transmission, Vulnerabilities in any computing system and security solution.
- To apply channel allocation, framing, error and flow control techniques.
- To describe the functions of Network Layer i.e. Logical addressing, sub netting & Routing Mechanism.
- To explain the different Transport Layer function i.e. Port addressing, Connection Management, Error control and Flow control mechanism.
- To explain the functions offered by session and presentation layer and their Implementation.
- To explain the different protocols used at application layer i.e. HTTP, SNMP, SMTP, FTP, TELNET and VPN.

Nature of Paper: Department Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introductory Concepts**: Goals, applications and categories of networks, Internet Organization, ISP, Network structure and architecture (layering principles, services, protocols and standards), Overview of OSI reference model, Overview of TCP/IP protocol suite, Network devices and components. **Physical Layer:** Network topology design, Types of connections, Transmission media, Signal transmission and encoding, Network performance and transmission impairments, Switching techniques and multiplexing.	**8L**
II	**Link layer:** Framing, Error Detection and Correction, Flow control (Elementary Data LinkProtocols, Sliding Window protocols). Medium Access Control and Local Area Networks: Channel allocation, Multiple access protocols, LAN standards, Link layer switches & bridges (learning bridge and spanning tree algorithms).	**8L**
III	**Network Layer:** Point-to-point networks, Logical addressing, Basic internetworking (IP, CIDR, ARP, RARP, DHCP, ICMP),	**8L**

	Routing, forwarding and delivery, Static and dynamic routing,Routing algorithms and protocols, Congestion control algorithms, IPv6.	
IV	**Transport Layer:** Process-to-process delivery, Transport layer protocols (UDP and TCP), Multiplexing, Connection management, Flow control and retransmission, Window management,TCP Congestion control, Quality of service.	**8L**
V	**Application Layer:** DNS, WWW and HTTP,Electronic mail, FTP, Remote login, Network management, Data compression, Cryptography – basic concepts.	**8L**

Reference / Text Books:

1. Behrouz Forouzan, "Data Communication and Networking", McGraw Hill
2. Andrew Tanenbaum "Computer Networks", Prentice Hall.
3. William Stallings, "Data and Computer Communication", Pearson
4. Kurose and Ross, "Computer Networking- A Top-Down Approach", Pearson.
5. Peterson and Davie, "Computer Networks: A Systems Approach", Morgan Kaufmann

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course: NIL

Course Learning Outcomes:

After completing the course, students should be able to:

- Explain basic concepts, OSI reference model, services and role of each layer of OSI model and TCP/IP, networks devices and transmission media, Analog and digital data transmission
- Apply channel allocation, framing, error and flow control techniques.
- Describe the functions of Network Layer i.e. Logical addressing, sub netting & Routing Mechanism.
- Explain the different Transport Layer function i.e. Port addressing, Connection Management, Error control and Flow control mechanism.
- Explain the functions offered by session and presentation layer and their Implementation.
- Explain the different protocols used at application layer i.e. HTTP, SNMP, SMTP, FTP, TELNET and VPN

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B.Tech CSE(AIML)**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Compiler Design**
Course Code: SDAIML-362	**Title: Compiler Design**

Course Objectives:
The Student will Learn:

- To understand the concept of phases and passes of compiler and its tools like LEX and YAAC.
- To acquaint with knowledge of various parsers and parsing techniques.
- To analyze and implement compiler by Syntax-directed Translation schemes.
- To understand the concept of symbol table and error detection and recovery mechanism.
- To understand the concept of code generation and code optimization.

Nature of Paper: Department Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Compiler:** Phases and passes, Bootstrapping, Finite state machines and regular expressions and their applications to lexical analysis, Optimization of DFA-Based Pattern Matchers implementation of lexical analyzers, lexical-analyzer generator, LEX compiler, Formal grammars and their application to syntax analysis, BNF notation, ambiguity, YACC. The syntactic specification of programming languages: Context free grammars, derivation and parse trees, capabilities of CFG.	**8L**
II	**Basic Parsing Techniques:** Parsers, Shift reduce parsing, operator precedence parsing, top down parsing, predictive parsers Automatic Construction of efficient Parsers: LR parsers, the canonical Collection of LR(0) items, constructing SLR parsing tables, constructing Canonical LR parsing tables, Constructing LALR parsing tables, using ambiguous grammars, an automatic parser generator, implementation of LR parsing tables.	**8L**
III	**Syntax-directed Translation:** Syntax-directed Translation schemes, Implementation of Syntax directed Translators, Intermediate code, postfix notation, Parse trees & syntax trees, three address code, quadruple & triples, translation of assignment statements, Boolean expressions, statements that alter the flow of control, postfix translation, translation with a top down parser. More about translation: Array references in arithmetic expressions, procedures	**8L**

	call, declarations and case statements	
IV	**Symbol Tables:** Data structure for symbols tables, representing scope information. **Run-Time Administration:** Implementation of simple stack allocation scheme, storage allocation in block structured language. **Error Detection & Recovery:** Lexical Phase errors, syntactic phase errors semantic errors.	**8L**
V	**Code Generation**: Design Issues, the Target Language. Addresses in the Target Code, Basic Blocks and Flow Graphs, Optimization of Basic Blocks, Code Generator. **Code optimization:** Machine-Independent Optimizations, Loop optimization, DAG representation of basic blocks, value numbers and algebraic laws, Global Data-Flow analysis.	**8L**

Reference / Text Books:

1. K. Muneeswaran,Compiler Design,First Edition,Oxford University Press.
2. J.P. Bennet, "Introduction to Compiler Techniques", Second Edition, Tata McGraw-Hill, 2003.
3. Henk Alblas and Albert Nymeyer, "Practice and Principles of Compiler Building with C", PHI, 2001.
4. Aho, Sethi & Ullman, "Compilers: Principles, Techniques and Tools", Pearson Education
5. V Raghvan, " Principles of Compiler Design", TMH
6. Kenneth Louden," Compiler Construction", Cengage Learning.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course: Theory of Formal Languages and Automata

Course Learning Outcomes:

After completing the course, students should be able to:

- To explain the different phases and passes of compiler and eventually recognize patterns, tokens and regular expressions.
- To implement the concept of parsers and construct the parsing tables
- To illustrate and create the intermediate code
- To analyze and implement compiler by Syntax-directed Translation schemes.
- To summarize the knowledge of various parsers and parsing techniques.
- To intregate the concept of code generation and code optimization.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B.Tech CSE(AIML)**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Human Computer Interface**
Course Code: SDAIML-363	**Title: Human Computer Interface**

Course Objectives:
The Student will Learn:
1. To introduce the concept of user interface and graphical user interface.
2. To acquaint the concept of design process.
3. To understand the concepts of screen designing.
4. To introduce the concept of windows and multimedia.
5. To understand the applications of software tools and interaction tools.

Nature of Paper: Department Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Importance of user Interface its definition, importance and benefits of good design, Overview history of Screen design. The graphical user interface – popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user – Interface popularity, characteristics- Principles of user interface	**8L**
II	Design process: Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, understanding business junctions. Screen Designing: Design goals of screen designing.	**8L**
III	Screen Designing : Design goals – Screen planning and purpose, organizing screen elements, ordering of screen data and content – screen navigation and flow – Visually pleasing composition – amount of information – focus and emphasis – presentation information simply and meaningfully – information retrieval on web – statistical graphics – Technological consideration in interface design.	**8L**
IV	Windows: New and Navigation schemes selection of window, selection of devices based and screen based controls. Components – text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors	**8L**
V	Software tools: Specification methods, interface – Building Tools. Interaction Devices – Keyboard and function keys – pointing devices	**8L**

	– speech recognition digitization and generation – image and video displays – drivers.	

Reference / Text Books:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale Human Computer Interaction, 3rd Edition Prentice Hall, 2004.
2. Jonathan Lazar Jinjuan Heidi Feng, Harry Hochheiser, Research Methods in Human Computer Interaction, Wiley, 2010.
3. Ben Shneiderman and Catherine Plaisant Designing the User Interface: Strategies for Effective Human-Computer Interaction (5th Edition, pp. 672, ISBN 0- 321-53735-1, March 2009), Reading, MA: Addison-Wesley Publishing Co.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course: Nil

Course Learning Outcomes:

After completing the course, students should be able to:

1. Understanding user interface good design.
2. Analyzing the design process and understanding human interaction with computers.
3. Analyzing the screen design process and understanding human interaction with computers.
4. Understand the technological consideration in interface design.
5. Understanding windows, components and multimedia.
6. Understanding software tools and interaction devices.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B.Tech (CSE-AIML)**	**Year: III** **Semester: VI**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: BIG DATA**
Course Code: SDAIML-364	**Title: BIG DATA**

Course Objectives:
The Student will Learn:

- To demonstrate knowledge of Big Data Analytics concepts and its applications in business.
- To demonstrate functions and components of Map Reduce Framework and HDFS.
- To discuss Data Management concepts in NoSQL environment.
- To explain process of developing Map Reduce based distributed processing applications.
- To explain process of developing applications using HBASE, Hive, Pig etc.
- To demonstrate knowledge of Big Data Analytics concepts and its applications in business.

Nature of Paper: Department Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Big Data**: Types of digital data, history of Big Data innovation, introduction to Big Data platform, drivers for Big Data, Big Data architecture and characteristics, 5 Vs of Big Data, Big Data technology components, Big Data importance and applications, Big Data features – security, compliance, auditing and protection, Big Data privacy and ethics, Big Data Analytics, Challenges of conventional systems, intelligent data analysis, nature of data, analytic processes and tools, analysis vs reporting, modern data analytic tools.	**8L**
II	**Hadoop:** History of Hadoop, Apache Hadoop, the Hadoop Distributed File System, components of Hadoop, data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, Hadoop Echo System. **Map Reduce:** Map Reduce framework and basics, how Map Reduce works, developing a Map Reduce application, unit tests with MR unit, test data and local tests, anatomy of a Map Reduce job run, failures, job scheduling, shuffle and sort, task execution, Map Reduce types, input formats, output formats, Map Reduce features, Real-world Map Reduce	**8L**
III	**HDFS (Hadoop Distributed File System):** Design of HDFS, HDFS concepts, benefits and challenges, file sizes, block sizes and block	**8L**

	abstraction in HDFS, data replication, how does HDFS store, read, and write files, Java interfaces to HDFS, command line interface, Hadoop file system interfaces, data flow, data ingest with Flume and Scoop, Hadoop archives, Hadoop I/O: compression, serialization, Avro and file-based data structures. **Hadoop Environment:** Setting up a Hadoop cluster, cluster specification, cluster setup and installation, Hadoop configuration, security in Hadoop, administering Hadoop, HDFS monitoring & maintenance, Hadoop benchmarks, Hadoop in the cloud	
IV	**Hadoop Eco System and YARN**: Hadoop ecosystem components, schedulers, fair and capacity, Hadoop 2.0 New Features - NameNode high availability, HDFS federation, MRv2, YARN, Running MRv1 in YARN. **NoSQL Databases:** Introduction to NoSQL **MongoDB:** Introduction, data types, creating, updating and deleting documents, querying,introduction to indexing, capped collections **Spark:** Installing spark, spark applications, jobs, stages and tasks, Resilient DistributedDatabases, anatomy of a Spark job run, Spark on YARN **SCALA:** Introduction, classes and objects, basic types and operators, built-in control structures, functions and closures, inheritance.	**8L**
V	**Hadoop Eco System Frameworks**: Applications on Big Data using Pig, Hive and HBase **Pig** - Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators. **Hive** - Apache Hive architecture and installation, Hive shell, Hive services, Hive metastore, comparison with traditional databases, HiveQL, tables, querying data and user defined functions, sorting and aggregating, Map Reduce scripts, joins & subqueries. **HBase** – Hbase concepts, clients, example, Hbase vs RDBMS, advanced usage, schema design, advance indexing, Zookeeper – how it helps in monitoring a cluster, how to build applications with Zookeeper. IBM Big Data strategy, introduction to Infosphere, BigInsights and Big Sheets, introduction to Big SQL.	**8L**

Reference / Text Books:

1. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging BusinessIntelligence and Analytic Trends for Today's Businesses", Wiley
2. Big-Data Black Book, DT Editorial Services, Wiley
3. Dirk deRoos, Chris Eaton, George Lapis, Paul Zikopoulos, Tom Deutsch, "Understanding Big Data Analytics forEnterprise Class Hadoop and Streaming Data", McGrawHill.
4. Thomas Erl, Wajid Khattak, Paul Buhler, "Big Data Fundamentals: Concepts, Drivers and Techniques", PrenticeHall.
5. Bart Baesens "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications (WILEYBig Data Series)", John Wiley & Sons
6. ArshdeepBahga, Vijay Madisetti, "Big Data Science & Analytics: A HandsOn Approach ", VPT

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course: DBMS

Course Learning Outcomes:

After completing the course, students should be able to:

- Demonstrate knowledge of Big Data Analytics concepts and its applications in business.
- Demonstrate functions and components of Map Reduce Framework and HDFS
- Discuss Data Management concepts in NoSQL environment.
- Explain process of developing Map Reduce based distributed processing applications.
- Explain process of developing applications using HBASE, Hive, Pig etc.
- Explain demonstrate knowledge of Big Data Analytics concepts and its applications in business.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B.Tech CSE(AIML)**	**Year: III** **Semester: VI**
Credits: 3 **Theory: 3** **Practical: 0**	**Subject: Universal Human Values & Professional Ethics**
Course Code: UVE-601	**Title: Universal Human Values & Professional Ethics**

Course Objectives:
The Student will Learn:

1. To reinstate the rich cultural legacy and human values of which we are thecustodians.
2. To focus on professional ethics which are broader indicators of desirable actions vis-à-vis undesirable actions.
3. To lay down broader guidelines of values and ethics for internal and externalstakeholders.
4. To suggest operational guidelines for value-based and ethical practices in the higher educational institutions leading to implementation and monitoring.
5. To indicate the outcomes of creating a value-based and ethical culture inHEIs.
6. To suggest indicative reinforcement programm for nurturing humanvalues and ethics in HEIs.

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 3 Credits

L:3
T:0
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (3Hrs./Week=3Credits)

Unit	Contents	No. of Lectures Allotted
I	**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education:** Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.	**8L**
II	**Understanding Harmony in the Human Being - Harmony in Myself:** Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony	**8L**

	in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.	
III	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship:**Understanding harmony in the Family- the basic unit of human interaction , Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding the meaning of Vishwas; Difference between intention and competence, Understanding the meaning of Samman, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society (AkhandSamaj), Universal Order (SarvabhaumVyawastha)- from family to world family!. Universal Human Values of truth (Satya), nonviolence, love (Prem), Peace (Shanti) and righteous conduct (dharma).	**8L**
IV	**Understanding Harmony in the Nature and Existence - Whole existence as Co-existence:** Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.	**8L**
V	**Implications of the above Holistic Understanding of Harmony on Professional Ethics:** Natural acceptance of human values, Definiteness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations. Workshop on Life Skills	**8L**

Reference / Text Books:

1. R R Gaur, R Sangal, G P Bagaria, 2009, a Foundation Course in HumanValues and Professional Ethics.
2. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
3. E.F. Schumacher, 1973, small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.

4. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
5. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
6. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	10
2) Presentations /Seminar	-
3) Assignments	05
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	35
Total:	**50**

Prerequisites for the course: NIL

Course Learning Outcomes:

After completing the course, students should be able to:

1. Explain learning process for holistic development
2. Define Impeccable governance
3. Explain Effective institutional management
4. Use Well laid system of rewards and chastisement
5. Analyse Institutional climate where 'rights' enjoy and 'wrongs' are discouraged.
6. Development of Humanistic, Ethical, Constitutional and Universal Human Values .

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B. Tech (CSE-AIML)**	**Year: III** **Semester: VI**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Data Science Tools and Techniques Lab**
Course Code: SEAIML-361P	**Title: Data Science Tools and Techniques Lab**
Nature of Paper: Engineering Courses (Core)	
Minimum Passing Marks/Credits: 50% Marks / 2 Credits	

L:0
T:0
P:4 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Name of the Practical	No. of Lectures Allotted for practical
I	Installation of Hadoop	2
II	Work with Mango DB, Get / Post method in Mango DB	2
III	Implement various graphs on different data using matplotlib & Seaborn.	2
IV	understand Hadoop I/O	2
V	Understand map reduce Fundamentals, putting map reduce together, optimization in map reduce.	2
VI	Use big data tools pig, spark, hive, zookeeper, Hbase	2
VII	Understand dataflow in Hadoop	2
VIII	Load balancing in Hadoop.	2
IX	Manage security credential, compression, serialization in Hadoop.	2

Reference / Text Books:
1. J. Janssens, Data science at the command line, First edition. Sebastopol, CA: O'Reilly, 2014.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	30
Total:	**50**

Prerequisites for the course: NA

Course Learning Outcomes: After completing the course, students should be able
1. To understand the various concepts in Data Science process.
2. To study the applications of Data Science.
3. To learn to setup the data science tools environment and implement in Python and R.
4. To learn to write programs in Python and R for data science projects.
5. To know the process of data visualization.
6. Data manipulation w.r.to data science.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

Programme: UG(R) **Class: B. Tech CSE(AIML)**	**Year: III** **Semester: VI**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Natural Language Processing Lab**
Course Code: SEAIML-362 P	**Title: Natural Language Processing Lab**
Nature of Paper: Engineering Courses (Core)	
Minimum Passing Marks/Credits: 50% Marks / 2 Credits	

L:0
T:0
P:4 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Name of the Practical	No. of Lectures Allotted for practical
I	NLP Implementation	2
II	Use open source NLP library (NLTK)	2
III	Tokenization	2
IV	Statical word frequency – text processing , use python NLTK library to count the frequency distribution of the token	2
V	Word analysis and word generation	2
VI	Morphology	2
VII	N – grams and n-grams smoothing	2
VIII	POS tagging: hidden Markov model	2
IX	POS tagging: Viterbi decoding	2
X	Chunking , building chunker	2

Reference / Text Books:

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	30
Total:	**50**

Prerequisites for the course: NA

Course Learning Outcomes:
After completing the course, students should be able to
1. Understand the Introduction to Natural Language Toolkit (NLTK).
2. Understand Python quick overview.
3. Apply Lexical analysis: Word and text tokenizer.
4. Apply n-gram and collocations.
5. Understand NLTK corpora.
6. Apply Naive Bayes classifier with NLTK.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VII

Programme: UG(R) **Class: B. Tech (CSE-AIML)**	**Year: IV** **Semester: VII**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Data Visualization Lab**
Course Code: SEAIML-471P	**Title: Data Visualization Lab**

Course Objectives:

- Student will be able to develop proficiency in using data visualization tools, such as Tableau, Power BI, or other software, to create charts, graphs, and other visualizations.
- Student will be able to gain an understanding of best practices in data visualization, including the principles of good design, effective use of color, and appropriate choice of chart types.
- Student will be able to analyze and interpret data using visualizations, and identify patterns, trends, and relationships within the data.
- Student will be able to develop proficiency in using various chart types, such as bar charts, line charts, scatter plots, heat maps, and tree maps, to visualize different types of data and relationships.

Nature of Paper: Engineering Courses (Core)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits

L:0
T:0
P:4 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Name of the Practical	No. of Lectures Allotted for practical
I	Create a scatter plot in Excel using a data set of your choice, and adjust the chart's axis labels, titles, and colors.	
II	Use Tableau to create a bar chart that compares sales by product category for a given time period, and apply filters to show sales by region or other variables.	
III	Create a bubble chart in Power BI that visualizes the relationship between three variables, such as sales, profit, and customer satisfaction.	
IV	create a line chart that shows changes in temperature over time, and add markers to highlight extreme temperatures or other events.	
V	Create a heat map in Tableau that shows the distribution of crime incidents by neighborhood, and use color to indicate the severity of the incidents.	
VI	Use Power BI to create a tree map that visualizes the distribution of sales by product category and sub-category, and use tooltips to show additional details.	
VII	Create a scatter plot matrix that visualizes the pairwise relationships between multiple variables in a data set.	
VIII	Use Tableau to create a stacked bar chart that shows the	

	breakdown of sales by product category and sub-category, and apply filters to show sales by region or other variables.	
IX	Create a funnel chart in Power BI that shows the conversion rates at various stages of a sales funnel, and use annotations to highlight key points.	
X	Create a Pareto chart that shows the relative frequency and cumulative percentage of defects or other quality metrics in a process	

Learning Outcomes:

- After completion of the course students would be able to :
- Build data models and manage and manipulate data to extract useful information and insights
- Apply functions to manipulate and analyze data
- Discover customer preference, purchasing habits, and other behaviors
- Analyze internal and external factors by understanding "Mind and Market Factors" component of MIMI
- Make use of Tableau software for data visualization

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

Programme: Under Graduate **Class: B-Tech (CSE-AIML)**	**Year: IV** **Semester: VIII**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Mobile Computing**
Course Code: SDAIML-481	**Title: Mobile Computing**

Course Objectives:

1. Students will be able to explain and discuss issues in mobile computing and illustrate overview of wireless telephony and channel allocation in cellular systems.
2. Students will be able to explore the concept of Wireless Networking and Wireless LAN.
3. Students will be able to analyze and comprehend Data management issues like data replication for mobile computers, adaptive clustering for mobile wireless networks and Disconnected operations.
4. Students will be able to Identify Mobile computing Agents and state the issues pertaining to security and fault tolerance in mobile computing environment.
5. Students will be able to compare and contrast various routing protocols and will identify and interpret the performance of network systems using Adhoc networks.

Nature of Paper: Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 1
P: 0 (In Hours/Week)
Theory – 3, Practical- 0

Unit	Contents	No. of Lectures Allotted
I	Introduction and issues in mobile computing, Details of wireless telephony: details of cellular concept, GSM details, air-interface in GSM, channel structure in GSM, location management: HLR-VLR, hierarchical, handoffs, channel allocation in cellular systems, Review of CDMA and GPRS.	10
II	Overview of wireless networking, Overview of wireless LAN: Medium access control issues, Overview of IEEE802.11, Overview of Bluetooth technology, Overview of wireless multiple access protocols, Comparison of Transmission control protocol over wireless transmission control protocol, Explanation of wireless applications, data broadcasting, Overview of Mobile IP. WAP: Architecture, protocol stack, application environment and applications.	10
III	Discussion of data management issues, Overview of data replication for mobile computers, Overview of adaptive clustering for mobile wireless networks: File system and Disconnected operations.	10
IV	Concept of mobile agents, Concept of security and fault tolerance and overview of transaction processing in mobile computing environment.	10
V	AdHoc networks: Issues of localization, overview of medium access control issues, discussion of Routing protocols, Understanding global state routing(GSR),Destination sequenced distance vector routing (DSDV), Dynamic source routing (DSR), Ad Hoc on demand distance vector routing(AODV),	10

	Temporary ordered routing algorithm(TORA), Explanation of quality of service in Ad-hoc networks, applications.	

Evaluation/Assessment Methodology	
	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Assignments	20
3) External Theory	100
Total:	**150**

Course Learning Outcomes: Student will be able to

1. Discuss the issues in mobile computing and overview of wireless telephony and allocation of channel in cellular networks.
2. Walkthrough through the concept of Wireless Networking and Wireless local area networks.
3. Learn Data management issues like data replication for mobile computers, adaptive clustering for mobile wireless networks and disconnected operations, analysis and comprehension.
4. Identify Mobile computing Agents and state the issues pertaining to security and fault tolerance in mobile computing environment.
5. Compare and contrast various routing protocols and will identify and interpret the performance of network systems using Ad-hoc networks.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

Programme: UG(R) **Class: B-Tech (CSE-AIML)**	**Year: IV** **Semester: VIII**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: INTERNET OF THINGS**
Course Code: SDAIML-482	**Title: INTERNET OF THINGS**

Course Objectives:

1. Vision and introduction to IOT.
2. Understand IOT market perspective.
3. Data and knowledge management and use of devices in IOT technology.
4. Understand the State of the art-IOT Architecture.
5. Understand real world IoT design, constraints, IoT Automation and Commercial building automation in IoT.

Nature of Paper: Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3,
T: 1,
P: 0 (In Hours/Week)
Theory – 3, Practical- 0

Unit	Contents	No. of Lectures Allotted
I	Internet of Things (IoT): Vision, Definition, Conceptual Framework, Architectural view, technology behind IoT, IoT sources, M2M Communication, Examples of IoT. Design Principles for Connected Devices: IoT/M2M systems layers, design standardization, communication technologies, data enrichment, consolidation, ease of designing, affordability.	10
II	Wireless Medium access issues, medium access protocol survey, Survey routing protocols, Sensor deployment, Node discovery, Data aggregation & dissemination.	10
III	Ardunio Platform Boards Anatomy, Ardunio IDE, coding, using emulator, using libraries, additions in ardunio, IoT programming using Arduino.	10
IV	Development Challenges, Security Challenges, Other challenges in IoT Applications: Overview of Smart Metering, E-health, City Automation, Automotive Applications, home automation, smart cards, communicating data with H/W units, mobiles, tablets, Designing of smart street lights in smart city using IoT.	10

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Assignments	20
3) External Theory	100
Total:	**150**

Course Learning Outcomes: Student will be able to

1. Demonstrate basic concepts of IoT, and understand the principles and challenges in IoT implementation.
2. Understand the functioning of hardware devices and sensors used in IoT.
3. Network communication aspects and protocols used in IoT are part of analysis.
4. Apply IoT for developing real life applications using Ardunio programming.
5. Development of IoT infrastructure for popular applications.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

Programme: UG **Class: B-Tech (CSE-AIML)**	**Year: IV** **Semester: VIII**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: CLOUD COMPUTING**
Course Code: SDAIML-483	**Title: CLOUD COMPUTING**

Course Objectives:

1. Understand the basic principles of cloud computing.
2. To study the basic technologies that forms the foundations of Big Data.
3. To study the programming aspects of cloud computing with a view to rapid prototyping of complex applications.
4. To understand the specialized aspects of big data including big data application, and big data analytics.
5. To study different types Case studies on the current research and applications of the Hadoop and big data in industry

Nature of Paper: Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3,
T: 1,
P: 0 (In Hours/Week)
Theory – 3,
Practical- 0

Unit	Contents	No. of Lectures Allotted
I	Overview of Cloud Computing, history, definition and evolution, Underlying concept of Parallel and Distributed computing, Cloud Architecture, and its types. Business models built around cloud technology, Case studies of major players in Cloud Computing. Discussion of issues in Clouds, Eucalyptus, Nimbus, Open Nebula, and CloudSim.	10
II	Overview of Cloud Services, Software as a Service Platform, Infrastructure as a Service, Database as a Service, Monitoring as a Service, communication as services. Discussion of service providers such as Google, Amazon, Microsoft Azure, IBM, Sales force.	10
III	Collaborating Using Cloud Services such as Email Communication over the Cloud, Project Management, Calendar, Schedules, Word Processing, Presentation, Spreadsheet, Databases, Desktop, Social Networks, customer relationship management and Groupware.	10
IV	Virtualization, Need, Pros and cons, Types of Virtualization in cloud, System and Process VM, Virtual Machine monitor, machine, Interpretation and binary translation, Overview of HLL VM supervisors, Xen, KVM, VMware, Virtual Box, Hyper-V.	10
V	Security in Clouds and challenges, Software as a Service Security, Overview of Common Standards in cloud i.e The Open Cloud Consortium ,The Distributed	10

	management Task Force, Standards for application Developers, Standards for Messaging, Standards for Security, End user access to cloud computing, Discussion on Mobile Internet devices and the cloud. Overview of Hadoop, MapReduce, Virtual Box.Discussion on Google App Engine and Programming Environment for Google App Engine	

Reference/ Text Book:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security, CRC Press, 2017.
3. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, ―Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
4. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing – A Practical Approach, Tata Mcgraw Hill, 2009.
5. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice), O'Reilly, 2009.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Assignments	20
3) External Theory	100
Total:	**150**

Course Learning Outcomes:

1. Student must be able to understand the building blocks of Big Data
2. Student must be able to articulate the programming aspects of cloud computing(map Reduce etc)
3. Student must be able to understand the specialized aspects of big data with the help of different big data applications
4. Student must be able to represent the analytical aspects of Big Data
5. Student must be know the recent research trends related to Hadoop File System, MapReduce and Google File System etc
6. Student must be able to understand the Security in Clouds and challenges

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

Programme: UG **Class: B.Tech (CSE-AIML)**	**Year: IV** **Semester: VIII**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Blockchain Architecture Design**
Course Code: SDAIML-484	**Title: Block chain Architecture Design**

Course Objectives:
1. Understanding the core concepts of Blockchain in details.
2. Impart strong technical understanding of consensus protocols.
3. Develop familiarity of current technologies, tools, and implementation strategies of blockchain
4. Understand use of Hyperledger fabric tool and its implementation.
5. Introduce application areas, current practices, and research activity

Nature of Paper: Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3,
T:1,
P:0(Hours/Week)
Theory – 3, Practical- 0

Unit	Contents	No. of Lectures Allotted
I	Overview of block chain, Journey of Digital Money to Distributed Ledgers, Design parameters: Protocols, Security, Consensus, Permissions, Privacy. Architecture and Design of Block chain: Discussion on crypto primitives: Signature and Hash, Journey of Hash chain to Blockchain, Primitive consensus mechanisms.	10
II	Consensus protocol requirements, Proof of Work , Scalability aspects of Blockchain consensus protocols, Permissioned Blockchains Consensus protocols and their design goals.	10
III	Overview of Hyperledger Fabric and their components, Decomposing the consensus process , Chain code Design and Implementation Hyperledger Fabric, Beyond Chain code fabric SDK and Front End and working of Hyperledger composer tool.	10
IV	Case study of Blockchain in Financial Software and Systems (FSS): (i) Settlements, (ii) KYC, (iii) Capital markets, (iv) Insurance. Case study of Blockchain in trade/supply chain: (i) Provenance of goods, visibility, trade/supply chain finance, invoice management discounting, etc	10
V	Case Study of Blockchain for Government: (i) Digital identity, land records and other kinds of record keeping between government entities, (ii) public distribution system social welfare systems Blockchain Cryptography, Privacy and Security on Blockchain	10

Reference/ Text Book:
1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas Antonopoulos.
2. Blockchain by Melanie Swa, O'Reilly.

3. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric.	
Evaluation/Assessment Methodology	
	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Assignments	20
3) External Theory	100
Total:	**150**

Course Learning Outcomes: Student will be able to learn

1. Basic understanding of Blockchain architecture along with its primitive.
2. Requirements for basic protocol along with scalability aspects.
3. Design and deploy the consensus process using frontend and backend.
4. Application of Blockchain techniques for different cases like Finance, Trade/Supply and Government activities.
5. Design and deploy the consensus process using frontend and backend.
6. Apply Block chain techniques for different use cases like Finance, Trade/Supply and Government activities.

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Evaluation Scheme

Evaluation Scheme – Bachelor of Technology (CE/EE/ME)
Year: I / Semester: I

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	ENAS-111	MATHEMATICAL THINKING WITH CALCULUS AND LINEAR ALGEBRA	Th	Core-1	3	1	0	4	30	20	50	100	150
2.	ENAS-112	MODERN PHYSICS IN ENGINEERING	Th	Core -2	3	1	0	4	30	20	50	100	150
	ENAS-113	ENGINEERING CHEMISTRY											
3.	ENME-111N	FUNDAMENTALS OF MECHANICAL AND MECHATRONICS SYSTEMS	Th	Core -3	3	1	0	4	30	20	50	100	150
4.	ENCS-111	STRUCTURED PROGRAMMING AND PROBLEM SOLVING IN C	Th	VAC-1	3	1	0	4	30	20	50	100	150
5.	ENAS-114	PROFESSIONAL COMMUNICATION AND DIGITAL FLUENCY	Th	AECC-1	3	1	0	4	30	20	50	100	150
	ENHU -112	ENVIRONMENT, ECOLOGY AND SUSTAINABILITY		AECC-2									
6.	ENAS-112P	MODERN PHYSICS IN ENGINEERING LAB	P	LAB-1	0	0	2	1	0	15	15	35	50
	ENAS-113P	ENGINEERING CHEMISTRY LAB											
7.	ENCS-111P	PROGRAMMING WITH C LAB: HANDS ON LOGIC BUILDING	P	LAB-2	0	0	2	1	0	15	15	35	50
8.	ENAS-114P	PROFESSIONAL COMMUNICATION AND DIGITAL FLUENCY	P	LAB-3	0	0	2	1	0	15	15	35	50
	ENHU -112P	ENVIRONMENT, ECOLOGY AND SUSTAINABILITY LAB											
9.	ENME-113P	INTRODUCTION TO CNC AND 3-D PRINTER LAB	P	SEC-1	0	0	2	2	0	15	15	35	50
10.	ENME-112P	MECHANICAL WORKSHOP LAB	P	LAB-5	0	0	2	1	0	15	15	35	50
	ENME-113P	ENGINEERING GRAPHICS & DESIGN LAB											
11.	ENPH-111	SPIRITUAL AND CULTURAL HERITAGE: INDIAN EXPERIENCE	P	AC	0	0	0	NC*	0	25*	25*	0	25*
12.	NECC -112*	UNIVERSITY SOCIAL RESPONSIBILITY -	P	AC	0	0	0	NC*	0	25*	25*	0	25*

		COMMUNITY OUTREACH											
13.	SPNC-111*	SPORTS	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**15**	**5**	**10**	**26**	**150**	**175**	**325**	**675**	**1000**

TH- Theory paper, P-Practical, L-Lecture, T-Tutorials, C-Credit, AECC – Ability Enhancement Compulsory Course, AC – Audit Courses, NC*-No Credit Course, CT – Class Test (Sessional Examinations), TA – Teacher's Assessment, ESE – End Semester Examinations.
University Social Responsibility& Sports - Community Outreach and Sports, Spiritual And Cultural Heritage: Indian Experience are Non-Credit Qualifying Courses. Their marks will not be added in final marks.

Note: NCC is offered as General Elective.
Note: A total of 8 Credits are mandatory to earn from NPTEL/Moocs/Coursers etc during 4 years of B.Tech Program.

Evaluation Scheme – Bachelor of Technology (CE/EE/ME)
Year: I / Semester: II

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	ENAS-121	APPLIED DIFFERENTIAL EQUATIONS	Th	Core-4	3	1	0	4	30	20	50	100	150
2.	ENAS-123	ENGINEERING CHEMISTRY	Th	Core-5	3	1	0	4	30	20	50	100	150
	ENAS-122	MODERN PHYSICS IN ENGINEERING											
3.	ENEE-121	ELECTRICAL & ELECTRONICS IN THE MODERN WORLD	Th	Core-6	3	1	0	4	30	20	50	100	150
4.	ENCS-121	FUNDAMENTAL CONCEPTS AND PROBLEM SOLVING WITH PYTHON	Th	VAC-2	3	1	0	4	30	20	50	100	150
5.	ENAS-124	PROFESSIONAL COMMUNICATION AND DIGITAL FLUENCY	Th	AECC-2	3	1	0	4	30	20	50	100	150
	ENHU -112	ENVIRONMENT, ECOLOGY AND SUSTAINABILITY		AECC-1									
6.	ENAS-123P	ENGINEERING CHEMISTRY LAB	P	LAB-6	0	0	2	1	0	15	15	35	50
	ENAS-122P	MODERN PHYSICS IN ENGINEERING LAB											
7.	ENCS-121P	FUNDAMENTAL CONCEPTS AND PROBLEM SOLVING WITH PYTHON LAB	P	LAB-7	0	0	2	1	0	15	15	35	50
8.	ENAS-124P	PROFESSIONAL COMMUNICATION AND DIGITAL FLUENCY LAB	P	LAB-8	0	0	2	1	0	15	15	35	50

	ENHU-112P	ENVIRONMENT, ECOLOGY AND SUSTAINABILITY LAB											
9.	ENEE-121P	ELECTRICAL & ELECTRONICS IN THE MODERN WORLD LAB	P	LAB-4	0	0	2	1	0	15	15	35	50
10.	ENME-123P	ENGINEERING GRAPHICS & DESIGN LAB	P	LAB-9	0	0	2	1	0	15	15	35	50
	ENME-122P	MECHANICAL WORKSHOP LAB											
11.	ENHW-121	HEALTH AND WELLNESS	P	AC	0	0	0	NC*	0	25*	25*	0	25*
12.	NECC-121*	INDUSTRIAL VISIT / SEMINAR ON THE REPORT OF VISIT	P	AC	0	0	0	NC*	0	25*	25*	0	25*
13.	NECC -122*	UNIVERSITY SOCIAL RESPONSIBILITY - COMMUNITY OUTREACH	P	AC	0	0	0	NC*	0	25*	25*	0	25*
14.	SPWC-111	SPORTS	P	LAB-10	0	0	2	1	0	0	0	25	25
Total					**15**	**5**	**12**	**26**	**150**	**175**	**325**	**700**	**1025**

TH- Theory paper, P-Practical, L-Lecture, T-Tutorials, C-Credit, AECC – Ability Enhancement Compulsory Course, AC – Audit Courses, NC*-No Credit Course, CT – Class Test (Sessional Examinations), TA – Teacher's Assessment, ESE – End Semester Examinations.
University Social Responsibility - Community Outreach and Sports, Industrial Visit, Health and Wellness are Non-Credit Qualifying Courses. Their marks will not be added in final marks.

Note: NCC is offered as General Elective
Note: A total of 8 Credits are mandatory to earn from NPTEL/Moocs/Coursers etc during 4 years of B.Tech Program.

Evaluation Scheme – Bachelor of Technology (Civil Engineering)
Year: II / Semester: III

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	RTAS-231/ RESE-231-238	Engineering Mathematics-III/ Engineering Science Elective	Th	Core-7	3	1	0	4	30	20	50	100	150
2.	RTCE-231	Mechanics of Solids	Th	Core-8	3	1	0	4	30	20	50	100	150
3.	RTCE-232	Surveying & Geomatics	Th	Core-9	3	1	0	4	30	20	50	100	150
4.	RTCE-233	Building Construction and Maintenance Engineering	Th	Core-10	3	1	0	4	30	20	50	100	150
5.	RSCE-231	Green Construction Material & Technology	Th	SEC-3	3	0	0	2	10	5	15	35	50
6.	RTCE-231P	Mechanics of Solids Lab	P	LAB-11	0	0	3	2	0	15	15	35	50

7.	RTCE-232P	Surveying & Geomatics Lab	P	LAB-12	0	0	3	2	0	15	15	35	50
8.	RTCE-233P	Building Construction and Maintenance Engineering Lab	P	LAB-13	0	0	3	2	0	15	15	35	50
9.	RTAS-232P	Integrated Communication Lab	P	AECC-3	0	0	3	2	0	15	15	35	50
10.	*NECC-232	University Social Responsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
11.	SPT-PC-111	Sports	P	AC	0	0	0	NC*	0	50*	50*	0	50*
Total					**15**	**4**	**12**	**26**	**130**	**145**	**275**	**575**	**850**

Th-Theory, L-Lecture, T-Tutorials, P-Practical (Labs), C-Credit, CT-Class Test (Sessional), TA-Teacher's Assessment (Attendance, Assignments, Tutorials, Class Tests, Quiz etc.), ESE-End Semester Examinations, NC*-Non-Credit Course, AC-Audit Course.

NECC-232* & SPT-231* are Non-credit courses (audit courses) and will be evaluated on the basis of a report presented by the student of his/her industrial visits, social visits/awareness campaigns/awareness rallies and participation in sports activities respectively during the semester. Student needs to qualify it but the marks will not be added in total marks.

NCC is offered as General Elective

Evaluation Scheme – Bachelor of Technology (Civil Engineering)
Year: II / Semester: IV

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	RTAS-241/ RESE-241-248	Engineering Mathematics-III/ Engineering Science Elective	Th	Core-11	3	1	0	4	30	20	50	100	150
2.	RTCE-241	Fluid Mechanics	Th	Core-12	3	1	0	4	30	20	50	100	150
3.	RTCE-242	Transportation Engineering	Th	Core-13	3	1	0	4	30	20	50	100	150
4.	IEMM-402, ASNL-402	VAC-3	Th	VAC-3	3	0	0	2	10	5	15	35	50
5.	RDCE-241-244	Discipline Specific Elective-1	Th	DSE-1	3	1	0	4	30	20	50	100	150
6.		Generic Elective-1	Th	GE-1	4	1	0	4	30	20	50	100	150
7.	RTCE-241P	Fluid Mechanics Lab	P	LAB-14	0	0	3	2	0	15	15	35	50
8.	RTCE-242P	Transportation Engineering Lab	P	LAB-15	0	0	3	2	0	15	15	35	50
9.	RTCE-243P	CAD Lab	P	LAB-16	0	0	3	2	0	15	15	35	50
10.	NECC-241	Industrial Visit/ Seminar/Presentation	P	AC	0	0	0	NC*	0	25*	25*	0	25*
11.	NECC-242	University Social Responsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
12.	SPT-PC-111	Sports	P	LAB-17	0	0	3	2	0	15	15	35	50
Total					**19**	**4**	**12**	**30**	**160**	**165**	**325**	**675**	**1000**
13.		**#Minor Certification Paper-1**			3	1	0	4	30	20	50	100	150

Th-Theory, L-Lecture, T-Tutorials, P-Practical (Labs), C-Credit, CT-Class Test (Sessional), TA-Teacher's Assessment (Attendance, Assignments, Tutorials, Class Tests, Quiz etc.), ESE-End Semester Examinations, NC*-Non-Credit Course, AC-Audit Course.
NECC-242* & SPT-241* are Non-credit courses (audit courses) and will be evaluated on the basis of a report presented by the student of his/her industrial visits, social visits/awareness campaigns/awareness rallies and participation in sports activities respectively during the semester. Student needs to qualify it but the marks will not be added in total marks.

Discipline Specific Elective-1	1. RDCE-241- Water Resource Engineering 2. RDCE-242- Concrete Technology 3. RDCE-243- Hydraulics and Hydraulic Machine 4. RDCE-244- Introduction to Sustainable Development
Generic Elective-I	This subject will be opted by student from other Schools of the IIMT University
Value Added Course	1. IEMM-402 Indian Ethos and Modern Management 2. ASNL-402 Ancient Sanskrit Language (Central Sanskrit University, Delhi)

NCC is offered as General Elective

Most Important regarding Internship: A minimum of 4-5 weeks internship is to be completed during summer break & its assessment will be done in 5th Semester.

#Minor Certification will be choice based and the student choosing any minor certification course has to clear all the three papers in three semesters (IV/ V/ VI Semester).

Evaluation Scheme – Bachelor of Technology (Civil Engineering)
Year: III / Semester: V

S. No	Subject Code	Subject Name	Evaluation Scheme									
			Periods			Internal Marks			External Marks		Total Marks	Credits
			L	T	P	CT	TA	IP	ET	EP		
1	SECE-351	Geotechnical Engineering	3	1	0	30	20	0	100	0	150	4
2	SECE-352	Structural Analysis	3	1	0	30	20	0	100	0	150	4
3	SECE-353	Design of concrete structure-I	3	1	0	30	20	0	100	0	150	4
4	SDCE-351 /SDCE-354	Department Specific Elective – II	3	1	0	30	20	0	100	0	150	4
5	SECE-351P	Geotechnical Engineering Lab	0	0	2	0	0	20	0	30	50	2
6	SECE-352P	Structural Analysis Lab	0	0	2	0	0	20	0	30	50	2
7	SECE-353P	Building planning and drawing Lab	0	0	2	0	0	20	0	30	50	2
8	SECE-354P	Internship Assessments/Industrial Training	0	0	2	0	0	50	0	0	50	2
9	SECE-359P	Research Project-I	0	0	2	0	0	50*	0	0	50*	NC
10	NECC-353	University Social Responsibility	0	0	0	0	0	25*	0	0	25*	NC
11	SPT-351	SPORTS	0	0	0	0	0	50*	0	0	50*	NC

		Grand Total	**12**	**4**	**10**	**120**	**80**	**110**	**400**	**90**	**800**	**24**

2 Credit Minor certification paper-2(Not to be included in the credit list)

L- Lecture, T- tutorials, P- Practical (Labs), CT- Class Test (Sessional), TA- Teacher's Assessment (Assignments, Tutorials), IP- Internal Practical, ET- External Theory, EP- external Practical, NC- Non Credit Course

***Note**: NECC-352& SPT-351are Noncredit courses (Audit Courses) and will be evaluated on the basis of report
Presented by the student of his/her industrial visits, social visits & sports activities respectively during the semester. Student needs to qualify it but the marks will not be added in total marks.

Skill Enhancement Courses	University Social Responsibility, MOOCS(SWAYAM/NPTEL)

Note: Internship to be done of minimum 4 weeks after summer break will be counted in 7th semester

Department Specific Elective - II

SDCE -351 Urban Transportation Planning
SDCE -352 Pavement Design
SDCE -353 Hydrology
SDCE-354 Estimating and costing

#Minor Certification will be choice based and the student choosing any minor certification course has to clear all the three papers in three semesters. The details are as below

Evaluation Scheme – Bachelor of Technology (Civil Engineering)
Year: III / Semester: VI

S. No.	Subject Code	Subject Name	Evaluation Scheme									
			Periods			Internal Marks			External Marks		Total Marks	Credits
			L	T	P	CT	TA	IP	ET	EP		
1	SECE-361	Environmental Engineering	3	1	0	30	20	0	100	0	150	4
2	SECE-362	Design of Concrete Structures-II	3	1	0	30	20	0	100	0	150	4
3	SDCE-361 /SDCE-364	Department Specific Elective -III	3	1	0	30	20	0	100	0	150	4
5	UVE-601	Universal Human Values & Professional Ethics	3	1	0	10	5	0	35	0	50	3
6	SECE-361P	Environmental Engineering Lab	0	0	2	0	0	20	0	30	50	2
7	SECE-363P	Mini project Lab	0	0	2	0	0	20	0	30	50	2
8	SECE-362P	Simulation Lab-I	0	0	2	0	0	20	0	30	50	2
9	SECE-369P	Research Project-II	0	0	2	0	0	50*	0	0	50*	NC
10	NECC-361	Industrial Visit/ Seminar/Presentation on the report of visits	0	0	0	0	0	25*	0	0	25*	NC

11	NECC-362	University Social Responsibility	0	0	0	0	0	25*	0	0	25*	NC
12	NECC-365	MOOC/ SWAYAM	0	0	2	0	0	50	0	0	50	2
13	*SPT-361	SPORTS	0	0	0	0	0	50*	0	0	50*	NC
		Grand Total	**12**	**4**	**10**	**100**	**65**	**140**	**335**	**60**	**700**	**23**

2 Credit Minor certification paper-3(Not to be included in the credit list)

L- Lecture, T- tutorials, P- Practical (Labs), CT- Class Test (Sessional), TA- Teacher's Assessment (Assignments, Tutorials), IP- Internal Practical, ET- External Theory, EP- external Practical, NC- Non Credit Course

***Note**: NECC-361, NECC-362& SPT-361are Noncredit courses (Audit Courses) and will be evaluated on the basis of report presented by the student of his/her industrial visits, social visits & sports activities respectively during the semester. Student needs to qualify it but the marks will not be added in total marks.

Skill Enhancement Courses	Industrial Visit/Seminar on the report of visit, University Social Responsibility, Moocs(SWAYAM/NPTEL)

Generic Elective-II- Student selects the Generic subject from other department

Department Specific Elective –III

SDCE-361 Railway and tunnels
SDCE-362 Principle of town planning and architecture
SDCE-363Ground water management
SDCE-364 Foundation engineering

Evaluation Scheme – Bachelor of Technology (Civil Engineering)
Year: IV / Semester: VII

S. No	Subject Code	Subject Name	Evaluation Scheme									
			Periods			Internal Marks			External Marks		Total Marks	Credits
			L	T	P	CT	TA	IP	ET	EP		
1	SECE-471	Design of Steel Structures	3	0	0	30	20	0	100	0	150	4
2	SDCE-471/SDCE-475	Departmental specific elective- IV	3	1	0	30	20	0	100	0	150	3
3	NECC-475	MOOCS/Swayam	0	0	2	0	0	0	50	0	50	2
4	SECE-471P	Non-destructive testing Lab	0	0	2	0	0	20	0	30	50	1
5	SECE-472P	Project Lab (Minor)	0	0	2	0	0	25	0	75	100	4
6	SECE-474P	Internship Assessments	0	0	2	0	0	25	0	75	100	5
7	SECE473P	Seminar/Presentation	0	0	2	0	0	50	0	0	50	1
8	NECC-472	University Social Responsibility	*0*	*0*	*0*	*0*	*0*	*25**	*0*	*0*	*25**	*NC**
9	SPT-471	SPORTS	*0*	*0*	*0*	*0*	*0*	*50**	*0*	*0*	*50**	*NC**
		Grand Total	**06**	**02**	**10**	**60**	**40**	**120**	**250**	**180**	**650**	**20**

L- Lecture, T- tutorials, P- Practical (Labs), CT- Class Test (Sessional), TA- Teacher's Assessment (Assignments, Tutorials), IP- Internal Practical, ET- External Theory, EP-

external Practical, NC- Non Credit Course
Departmental specific elective-IV SDCE -471 Solid Waste management SDCE -472 Earthquake resistance design of structure SDCE-473 Bridge engineering SDCE -474 Plastic analysis of structure

Evaluation Scheme – Bachelor of Technology (Civil Engineering)
Year: IV / Semester: VIII

S. No	Subject Code	Subject Name	Evaluation Scheme									
			Periods			Internal Marks			External Marks		Total Marks	Credits
			L	T	P	CT	TA	IP	ET	EP		
1	PRN-121	Research Methology	4	0	0	30	20	0	100	0	150	4
2	SECE-481P	Major Project	0	0	20	0	0	100	0	150	250	10
3	SDCE-481	CPM & PERT (Departmental Specific Elective-V)	4	0	0	30	20	0	100	0	150	4
		Grand Total	**08**	**0**	**20**	**60**	**40**	**100**	**200**	**150**	**550**	**18**

L- Lecture, T- tutorials, P- Practical (Labs), CT- Class Test (Sessional), TA- Teacher's Assessment (Assignments, Tutorials), IP- Internal Practical, ET- External Theory, EP- external Practical, NC- No n Credit Course

Departmental Specific Elective-V
SDCE-481 CPM & PERT
SDCE-482 Open Channel flow
SDCE-483 Pre-stressed concrete structures SDCE-484 River engineering

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Format-1

Format-1

CBCS: Statement of Credit distribution (w.e.f: Session 2024-25)

College/School: School of Engineering & Technology **Programme: B.Tech** **Duration: 8 Semester** **Annual/Semester: Semester**	**Credit range: 160-190** **(Suggested by** **CBCS Committee)**

COURSE	CREDIT	SEMESTER	CORE COURSE Major	DSE Minor	AECC	SEC	GE (Th 4) Interdisciplinary	General Elective	Value Added Course (VAC)	Industrial Training/ Survey / Research Project	Total Credits
No Exit Allowed	26	I	C-1 (4 Credit) C-2 (4 Credit)+P-01(1Credit) C-3 (4 Credit)+P-02(1Credit)		AECC-1 (4Credit)+ P-04 (1Credit)	SEC-1 P-(2 Credit)		NCC	VAC-1 (4 Credit) + P-9(1Credit)		26
	28	II	C-4 (4 Credit) C-5 (4 Credit)+P-05(1Credit) C-6 (4 Credit)+P-06(2Credit) P-8 (1 Credit)		AECC-2 (4Credit)+ P-04 (1Credit)	SEC-2 P-(2 Credit)		NCC	VAC-2 (4 Credit) + P-9(1Credit)		28
Certificate in Engineering	26	III	C-07(4 Credit) C-8 (4 Credit)+P-10(2 Credit) C-9 (4 Credit)+P-11(2 Credit) C-10 (4Credit)+P-12(2 Credit)		AECC-3 (P- 2Credit)	SEC-3 (2 Credit)		NCC			26
	28	IV	C-11(4 Credit) C-12 (4 Credit)+P-13(2 Credit) C-13 (4 Credit)+P-14(2 Credit) P-15(2 Credit)	DSE-1 (4 Credit)			GE-1 (4 Credit)	NCC	VAC-3 (2 Credit)		28
Diploma in Engineering	26	V	C-14 (4 Credit)+P-16(2 Credit) C-15 (4 Credit)+P-17(2 Credit) C-16 (4 Credit)+P-18(2 Credit)	DSE-2 (4 Credit)		SEC-4 (2 Credit)		NCC		INT-1 (2 Credit) RP-I (NC*)	26
	20	VI	C-17 (4 Credit)+P-19(2 Credit)	DSE-3	AECC-4	SEC-5		NCC		RP-II(NC*)	20

			C-18 (4 Credit)+P-20(2 Credit)	(4 Credit)	(2 Credit)	(2 Credit)					
B.Tech (Degree)	18	VII	C-19 (4 Credit)+P-21(2 Credit)			SEC-6 (2 Credit)	GE-2 (4 Credit)	NCC		INT-2 (2 Credit) Minor Project (4 Credit)	18
	18	VIII		DSE-4 (4 Credit)			GE-3 (4 Credit)	NCC		Major Project (10 Credit)	18
			19(Th)*4(C) = 76 04(Pr)*01(C) = 04 13(Pr)*2(C) = 26 **Total = 106**	4(Th)*4(C) =16 **Total =16**	02(Th)*04 (C)=8 02(Pr)*01 (C)=02 01(Pr)*02 (C)=02 01(Th)*02 (C)=02 **Total =14**	02(Pr)*02(C)=4 04(Th)*02(C)=8 **Total =12**	03(Th)*04(C)=12 **Total =12**		02(Th)*04 (C)=8 02(Pr)*01 (C)=02 01(Th)*02 (C) =02 **Total =12**	2+2+4+10=18 **Total =18**	**190**

IIMTU-NEP Implementation: (w.e.f. Session 2024-25) **Format-2 (B. Tech – Civil Engineering)**

Program	Year	Semester (15) weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester	Prerequisite	Elective (For other faculty)
BACHELOR OF TECHNOLOGY – CIVIL ENGINEERING	FIRST YEAR	SEMESTER -I	i) Core-1 (Th.4C)	4	5	45	Engineering Mathematics –I	5		SOBST
			ii) AECC-1 (Th.4 Cr+ P 1 C)	4 1	4 3	45 30	Effective Engineering Communication / Environment and Ecology Effective Engineering Communication Lab / Environment and Ecology Lab	5		SOAH
			iii) Core-2 (Th.4 Cr. + P 1 C).	4 1	5 3	45 30	Engineering Physics / Engineering Chemistry Engineering Physics Lab / Engineering Chemistry Lab	5		SOBST
			iv) Core-3 (Th. 4 C)	4	5	45	Introduction to Electrical and Electronics Engineering / Fundamental of Mechanical & Mechatronics systems	5		
			v) VAC-1 (Th.4 Cr. + P 1 C)	4 1	5 3	45 30	Structured Programming and Problem Solving in C Structured Programming and Problem Solving in C lab	5		
			vi) SEC-1(P 2C)/ Lab-4	2	3	30	Introduction to CNC and 3-D Printer Lab / Introduction to Electrical and Electronics Engineering Lab			
			vii) Lab-5 (P 1 C)	1	3	30	Mechanical Workshop Lab / Engineering Graphics & Design Lab			SOBST
			viii) Audit Course (AC)	NC	-	-	University Social Responsbility-Community Outreach			
			ix)Audit Course(AC)	NC	-	-	Sports			
		M E S T E	i) Core-4 (Th.4C)	4	5	45	Engineering Mathematics –II	5		SOBST

			ii) AECC-2 (Th.4 C+ P 1 C)	4 1	4 3	45 30	Environment and Ecology / Effective Engineering Communication Environment and Ecology Lab / Effective Engineering Communication Lab	5		SOAH
			iii) Core-5 (Th.4 C + P 1 C)	4 1	5 3	45 30	Engineering Chemistry/ Engineering Physics Engineering Chemistry Lab/ Engineering Physics Lab	5		SOBST
			iv) Core-6 (Th. 4 C)	4	5	45	Introduction to Electrical and Electronics Engineering / Fundamental of Mechanical & Mechatronics systems	5		
			v) VAC-2 (Th.4 C+ P 1 C)	4 1	5 3	45 30	Fundamental Concepts and Problem Solving with Python Fundamental Concepts and Problem Solving with Python Lab	5		
			vi) SEC-1(P 2C)/ Lab-4	2	3	30	Introduction to CNC and 3-D Printer Lab / Introduction to Electrical and Electronics Engineering Lab			
			vii) Lab-9 (P 1 C)	1	3	30	Mechanical Workshop Lab / Engineering Graphics & Design Lab			SOBST
			viii) SEC-2 (P 2 C)	2	3	30	Advance Industrial training in 'C' Lab			
			viii) Audit Course (AC)	NC	-	-	University Social Responsibility-Community Outreach			
			ix) LAB 10(P 2 C)	2	3	30	Sports			
Program Outcome: PO1 - PO12 [ANNEXTURE-1]							**Program Specific Outcome:** PSO1 - PSO4 [ANNEXTURE-2]			

Note: 1. A total of 8 Credits are mandatory to earn from NPTEL/Moocs/Coursera etc during 4 years of B.Tech Program.

Program	Year	Semester (15 weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester)	Prerequisite	Elective (For other faculty)
B. Tech Civil Engineering	SECOND YEAR	SEMESTER -III	i) Core-7 (Th. 4C)	4	5	45	Engineering Mathematics-III/ Engineering Science Elective	5		SOBST
			ii) Core-8 (Th. 4C + P 2C)	4 2	5 3	45 30	Mechanics of Solids Mechanics of Solids Lab	5		
			iii) Core-9 (Th. 4C + P 2C)	4 2	5 3	45 30	Surveying & Geomatics Surveying & Geomatics Lab	5		
			iv) Core-10 (Th. 4C + P 2C)	4 2	5 3	45 30	Building Construction and Maintenance Engineering Building Construction and Maintenance Engineering Lab	5		
			v) SEC-3 (Th. 2 C)	2	3	30	Green Construction Material & Technology	5		
			vi) AECC-3 (P 2C)	2	3	30	Integrated Ccommunication Lab	5		
			vii) Audit Course(AC)	NC	-	-	University Social Responsbility-Community Outreach			
			Viii)Audit Course(AC)	NC	-	-	Sports			
		SEMESTER -IV	i) Core-11 (Th. 4 C)	4	5	45	Engineering Mathematics-III/ Engineering Science Elective	5		SOBST
			ii) Core-12 (Th. 4C + P 2C)	4 2	5 3	45 30	Fluid Mechanics Fluid Mechanics Lab	5		
			iii) Core-13 (Th. 4C + P 2C)	4 2	5 3	45 30	Transportation Engineering Transportation Engineering Lab	5		
			iv) VAC-3 (Th.4 C)	2	3	30	1. Indian Ethos & Modern Management 2. Ancient Sanskrit Language (CSU Delhi)	5		
			v) LAB 16 (P 2 C)	2	3	30	CAD Lab	-		
			vi) DSE-1 (Th. 4 C)	4	5	45	5. Water Resource Engineering 6. Concrete Technology 7. Hydraulics and Hydraulic Machine 8. Introduction to Sustainable Development	5		
			vii) GE-1 (Th. 4 C)	4	5	45	***#To be opted from other School***	5		

			viii) Audit Course(AC)	NC	-	-	University Social Responsibility-Community Outreach	-		
			ix)LAB 17(P 2 C)	2	3	30	Sports	-		
*** Industrial Training of 4 Weeks/5Weeks to be completed between the semester break**							**#Minor Certification Paper-I**			
Programme Outcomes: PO_1 –PO_{12} **[ANNEXTURE-1]**							**Programme Specific Outcomes:** PSO_1 –PSO_4 **[ANNEXTURE-2]**			

Programme	Year	Semester (15 weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester)	Prerequisite	Elective (For other faculty)
	THIRD YEAR	SEMESTER -V	i) C16 (Th. 4 Cr. + P 2 Cr.)	4 2	4 3	48 36	Geotechnical Engineering Geotechnical Engineering Lab	5		
			ii) SEC-4	2	2	24	Internship*			
			iii) DSE-2	4	4	48	Urban Transportation Planning Pavement Design Hydrology Estimating and costing	5		
			i) C17 (Th. 4 Cr. + P 2 Cr.)	4 2	4 3	48 36	Structural Analysis Structural Analysis Lab	5		
			i) C18 (Th. 4 Cr.) ii) P 2 Cr.)	4 2	4 3	48 36	Design of concrete structure -I Building Planning and Drawing Lab	5		
		SEMESTER - VI	i) C19(Th. 4 Cr. + P 2Cr.)	4 2	4 3	48 36	Environmental Engineering Environmental Engineering Lab	5		
			ii) SEC-5	2	2	24	MOOCS (SWAYAM/ NPTEL)			
			iii) DSE-3	4	4	48	Railway and Tunnels Principle of Town Planning and Architecture Ground Water Management Foundation Engineering	5		
			i) C20 (Th. 4 Cr.) ii) P 2Cr.	4 2	4 3	48 36	Design of concrete structure –II Simulation Lab-I	5		

			i) AECC (Th. 3Cr) ii) SEC-6	3 2	3 3	36 36	Universal Human Values & Professional Ethics Mini project Lab	5		
*** Industrial Training of 4 Weeks/5Weeks to be completed between the semester break** **Programme Outcome:** PO_1-PO_{12} [Annexture-1]							**Programme Specific Outcome:** PSO_1-PSO_5 [Annexture-2]			

Programme	Year	Semester (15 weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester)	Prerequisite	Elective (For other faculty)
	FOURTH YEAR	SEMESTER -VII	i) C21 (Th. 4 Cr.) ii) 2Cr.) ii) SEC-7 iii) Project Lab (Minor)	4 2 2 4	4 3 2 8	48 36 24 96	Design of Steel Structure Non-Destructive Testing Lab MOOCS (SWAYAM/NPTEL) Minor Project*	5		
			i) SEC-6	2	2	24	Internship			
			i) GE-2	4	4	48	***#To be opted from other department***			
		SEMESTER - VIII	i) Generic Elective-4 (Th. 4Cr) ii) DSE-4 iii) Major Project	4 4 10	4 4 20	48 48 240	*Research Methodology* CPM & PERT Open Channel Flow Pre-Stressed concrete Structure River Engineering Major Project			
***Major Project report will be evaluated by external & internal examiners.** *** Industrial Training of 4 Weeks/5Weeks to be completed between the semester break**										
Programme Outcome: PO_1-PO_{12} [Annexture-1]							**Programme Specific Outcome:** PSO_1-PSO_5 [Annexture-2]			

ANNEXTURE-1

Program Outcomes:

PO1: **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2: **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: **Conduct investigations of complex problems**: Use research-based knowledge and Research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

ANNEXTURE-2

Program Specific Outcomes:

PSO1: Enabling students to learn continuously and to provide effective answers to new computational issues.

PSO2: Understand analyze data and create software to create computer-based systems of varying complexity that are designed effectively.

Format-3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech CE/EE/ME**			**Year: I** **Semester: I**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENAS-111**
4	**NA**	**Course Name**	**Mathematical Thinking with Calculus and Linear Algebra**

Course Objectives:

1. To gain the knowledge of differential calculus required for the field of engineering.
2. To deal with functions of several variables that is essential in optimizing the results of real life problems.
3. To understand Multiple integral tools to deal with engineering problems involving Surface area, volume etc.
4. To deal with vector calculus that is required in different branches of Engineering to graduate engineers.
5. To understand the essential tools of matrices and linear algebra, Eigen values and diagonalization in a Comprehensive manner are required.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Differential Calculus:** Rolle's Theorem, Mean Value Theorems, Successive Differentiation (nth order derivatives), Leibnitz theorem, Taylor's and Maclaurin's Theorems (without proof), Expansion of functions (standard forms),	**9L**
II	**Partial Differentiation:** Functions of several variables, Limit, Continuity, Partial derivatives, Euler's Theorem, Total derivative, Chain rule, Jacobians, Taylor's expansion for multivariable functions, Maxima and Minima of functions of two variables.	**9L**
III	**Integral Calculus:** Multiple integration: Double integral, Triple integral, Change of order of integration, Change of variables, Application: Areas and volumes.	**9L**
IV	**Vector Calculus:** Vector differentiation: Gradient, Curl and Divergence and their Physical interpretation, Directional derivatives. Vector Integration: Line integral, Surface integral, Volume integral, Gauss's Divergence theorem, Green's	**9L**

	theorem and Stoke's theorem (without proof) and their applications	
V	**Linear Algebra:** Types of Matrices: Symmetric, Skew-symmetric and Orthogonal Matrices; Complex Matrices, Inverse and Rank of matrix using elementary transformations, System of linear equations, Characteristic equation, Eigen values and eigenvectors, Cayley-Hamilton Theorem and its application, Diagonalization of a Matrix.	**9L**

Text Books:

1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*

Reference Books:

1. *E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.*
2. *Veerarajan T., Engineering Mathematics for first year, McGraw-Hill, New Delhi, 2008.*
3. *R K. Jain & S R K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House 2002*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	Understand the concept of differentiability and apply in the study of Successive differentiation, Leibnitz theorems and Partial differentiation.	**L2 & L3**
CO-2	Identify the application of partial differentiation and apply for evaluating maxima, minima, series and Jacobians.	**L3 &L4**
CO-3	Illustrate the working methods of multiple integral and apply for finding area, volume.	**L1& L3**
CO-4	Remember the concept of vector and apply for directional derivatives, tangent and normal planes. Also evaluate line, surface and volume integrals.	**L2 & L3**
CO-5	Remember the concept of matrices and apply for solving linear simultaneous equations.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	2	2	1	2	1	0	0	0	0	1	0
CO-3	2	2	0	1	1	0	0	0	0	0	0	2
CO-4	3	0	2	1	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech CE/EE/ME**			**Year: I** **Semester: I/II**
Credits: 5		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENAS-112/ENAS-122**
3	**2**	**Course Name**	**Modern Physics in Engineering**

Course Objectives:
1. To know the concept of Interference and Diffraction.
2. To know the significance of Maxwell's equations in the Engineering applications of electromagnetic waves.
3. Explain Quantum Mechanics to understand wave particle dualism. Necessity of quantum mechanics to explore.
4. To understand the concept of Relativistic Mechanics.
5. To understand the Phenomenon of Fiber optics and Laser.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 3 Credits (30% of ESE & 40% of total)
50% Marks / 2 Credits

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Wave Optics:** Interference: Basics of interference of light, coherent Sources, Conditions of Interference; Interference by division of wave front and amplitude (Interference due to thin film, Wedge shaped film and Newton's Rings). **Diffraction:** Fraunh offer Diffraction Due Single slit, Diffraction Grating; Diffraction due to N slits, Rayleigh's criterion of resolution; absent spectra, dispersive Power of grating, Resolving power of Grating.	**12L**
II	**Electromagnetic:** Gauss law Ampere's law and displacement current; Equation of continuity; Maxwell's equations in Integral and Differential Forms; Electromagnetic Wave Propagation in Free Space and Conducting Media; Poynting Theorem	**9L**
III	**Quantum Mechanics:** Planck's concept (hypothesis), Compton Effect, Particle properties of wave: Matter Waves, Davisson Germer Experiment, Heisenberg Uncertainty Principle, Wave function, and Schrodinger equation (time dependent & independent), Particle in a 1-D box.	**9L**

IV	**Relativistic Mechanics:** Inertial and Non- Inertial Frames; Michelson-Morley Experiment; Postulates of Special Theory of Relativity; Galilean and Lorentz Transformation; Length Contraction and Time Dilation; Addition of Velocities; Mass Energy Equivalence and Variation of Mass with Velocity.	**9L**
V	**Laser:** Absorption of radiation, Spontaneous and stimulated emission of radiation, Population inversion, Einstein's Coefficients, Principles of laser action, Components of laser, Solid state Laser (Ruby laser) and Gas Laser (He-Ne laser), Laser applications	**6L**

Text Books:
1. Concepts of Modern Physics - AurthurBeiser (Mc-Graw Hill)
2. Introduction to Special Theory of Relativity- Robert Resnick (Wiley)
3. Engineering Physics: Theory and Practical- Katiyar and Pandey (Wiley India)

Reference Books:
1. *Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New)*
2. *Engineering Physics-Malik HK and Singh AK (McGrawHill)*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	**Max. Marks**
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Physics of Class 12

Course Learning Outcomes:

CO-1	Apply the principles of wave optics to analyze and predict light behavior in various scenarios.	**L3 & L4**
CO-2	Analyze and solve problems involving electromagnetic fields and waves in various contexts.	**L4**
CO-3	Remember and apply the principles of quantum mechanics to understand and predict the behavior of particles at the atomic and subatomic levels.	**L1 & L3**
CO-4	Understand the principles of relativistic mechanics to analyze and predict the behavior of objects moving at velocities close to the speed of light.	**L2 & L4**
CO-5	Understand and apply the principles of laser technology.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B. Tech.** **CE/CSE/CSE(AIML)/ME/EE/AE**			**Year: I** **Semester: I/II**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENAS-113/ ENAS-123**
4	**NA**	**Course Name**	**ENGINEERING CHEMISTRY**

Course Objectives:

1. To enable the students to understand about the Chemistry of Atomic and Molecular structure, Chemistry of advanced Materials like Liquid crystals, Nanomaterials, Graphite & fullerenes, and Green Chemistry.
2. To enable the students to understand and apply the detailed concepts of spectroscopic techniques and stereochemistry to identify the compounds, element etc.
3. To enable the students to understand and apply the concepts related to Electrochemistry, Batteries, Corrosion and Chemistry of Engineering Materials like cement.
4. To enable the students to understand and apply detailed concepts of water source, water impurities, hardness of water and boiler troubles used in industry as well as analysis of coal & determination of calorific values.
5. To enable the students to understand detailed concepts related to polymers, Polymerization, Polymer Blends, Polymer Composites, and organometallic compounds.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Atomic and Molecular Structure:** Molecular orbitals of diatomic molecules (bond order, magnetic characters and numerical problems). **Chemistry of Advanced Materials:** ***Liquid Crystals;*** Introduction, Types and Applications of liquid crystals, industrially important materials used as liquid crystals. ***Graphite and Fullerene;*** Introduction, Structure and applications. ***Nanomaterials;*** Introduction, Preparation, characteristics of nanomaterials and applications of nanomaterials: Carbon Nano Tubes (CNT) and graphene. **Green Chemistry:** Introduction to green chemistry, 12 principles and importance of green Synthesis, Green Chemicals, Synthesis of typical organic compounds by conventional and Green routes (Adipic acid and Paracetamol), Environmental impact of Green chemistry on society.	**10L**

II	**Spectroscopic techniques and Applications:** Elementary idea and simple applications of Ultraviolet (UV) & Visible, fluorescence, Jablonski diagram, IR and Raman spectroscopy. **Stereochemistry:** Optical isomerism in compounds without chiral carbon, Geometrical isomerism, Chiral Drugs.	**8L**
III	**Electrochemistry:** Nernst Equation and application, relation of EMF with thermodynamic functions (ΔH, ΔF and Δ S). Lead storage battery. **Corrosion**; causes, effects and its prevention. **Chemistry of Engineering Materials:** ***Cement;*** Constituents, manufacturing, hardening and setting, deterioration of cement, Plaster of Paris (POP).	**9L**
IV	**Water Analysis:** Hardness of water, Techniques for water softening (Lime-soda, Zeolite, Ion exchange resin and Reverse osmosis method). **Fuels:** classification of fuels, Analysis of coal, Determination of calorific value (Bomb calorimeter and Dulon's method).	**8L**
V	**Polymers:** Basic concepts of Polymer-Blend and composites, Conducting and biodegradable polymers. Preparation and application of some industrially important polymers (Buna-S, Buna-N, Neoprene, Nylon-6, nylon-6,6, Teflon, Lucite, Bakelite, and Terylene). **Organometallic Compounds:** General methods of synthesis of organometallic compounds (Grignard reagent and lithium aluminum hydride) and their applications.	**9L**

Reference Books:

1. Engineering Chemistry by Rath & Singh, 2nd Edition, Cengage Learning India Pvt. Ltd Delhi.
2. Engineering Chemistry by SS Dara, S Chand & Co Ltd
3. Engineering Chemistry by Jain & Jain, S. Chand & Comp, New Delhi
4. Engineering Chemistry by K. Sesha Maheswaramma, Pearson
5. Engineering Chemistry by OG Palanna, Mc Graw Hill Education, New Delhi
6. Engineering Chemistry by Shashi Chawala, Dhanpat Rai Publishing Comp, New Delhi

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NA**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: NA

Course Learning Outcomes: After completion of the course, the student should be able to:

CO-1	Understand about the principles of atomic and molecular structure, bonding and properties, chemistry of advanced materials like Liquid Crystals, Nanomaterials, Graphite, graphene & Fullerenes as well as the principles of green chemistry.	**L1 & L2**
CO-2	Apply the fundamental concepts of determination of structure with various spectral techniques and stereochemistry	**L2 & L3**
CO-3	Apply the theory of construction of electrodes, batteries and fuel cells and re-designing or new engineering products, and categorize the reasons for corrosion and study methods to control corrosion, and develop an understanding of the chemistry of cement.	**L3 & L2**
CO-4	Understand the sources, impurities and hardness of water, apply the concepts of determination of calorific values and analyze the coal.	**L2, L3 & L4**
CO-5	Understand the chemical structure of polymers and its effect on their various properties when used as engineering materials. Understanding the applications of specific polymers and organometallic compounds, applicable in industrial process.	**L1 & L2**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	3	2	2	2	2	0	0	0	0	2
CO-2	2	3	2	3	3	1	1	0	0	0	0	2
CO-3	3	3	3	3	2	2	2	0	1	0	0	1
CO-4	3	3	3	2	2	2	2	0	0	0	0	1
CO-5	3	3	2	2	2	2	2	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech CSE**			**Year: I** **Semester: I/II**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENEE-111/ ENEE-121**
4	**NA**	**Course Name**	**ELECTRICAL & ELECTRONICS IN THE MODERN WORLD**

Course Objectives:

1. To provide students with a foundation in basic electrical and electronic principles.
2. To develop the ability to simplify complex DC networks
3. To introduce semiconductors and devices used in computers and modern electronics.
4. To connect electronics concepts with applications in computing, IoT, and automation.
5. To enable students to perform simple hands-on experiments using electronic components and microcontrollers.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	**T:** 1	**P:** 0	**C:** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Fundamentals of Electrical & Circuits** • Voltage, current, resistance, power (basic quantities) • Passive Components: Resistors, capacitors, inductors: functions, uses, and color coding • Ohm's Law and simple circuit calculations • Series and parallel combination of resistance, • AC vs DC supply (very basic introduction) • Application: Power supply in computers, mobile	**9L**
II	**DC Circuits** • Introduction to DC circuits, • Star-Delta conversion. • Kirchhoff's laws, • Mesh and nodal methods of analysis, • DC theorems: Thevinen's Theorem Norton's theorem, Maximum Power Transfer Theorem,	**9L**
III	**Introduction to Electronics: Semiconductor Basics & Devices** • Difference between electrical and electronics	**9L**

	• Role of electronics in computing, communication, healthcare, and automation • Conductors, semiconductors, insulators • Intrinsic & extrinsic semiconductors (p-type, n-type – simple explanation) • Active Components: Diodes, transistors, LEDs, ICs • PN junction diode: forward/reverse bias, • Transistors: concept as switch & amplifier	
IV	**Digital Electronics & Logic** • Binary number systems & voltage levels (0s and 1s) • Logic gates: AND, OR, NOT, NAND, NOR (truth tables & symbols) • Simplification of Boolean functions using K- Mapp (Upto 4 variables) • Simple combinational logic (half adder, encoder/decoder – basic idea)	**9L**
V	**Electronics in the Modern World** • Motherboards, chipsets, RAM, processors (basic blocks) • Consumer electronics: smartphones, smart TVs, laptops • Computer hardware: power supply, microprocessor basics • IoT and Embedded Systems: microcontrollers (Arduino, Raspberry Pi), sensors & actuators • Applications in automation, wearables, renewable energy devices • Emerging technologies: AI chips, quantum computing (intro only)	**9L**

Text Books:

1. Robert L. Boylestand / Louis Nashelsky "Electronic Devices and Circuit Theory", Pearson
2. Muthusubramanian, S. Salivahanan, "Basic Electrical and Electronics Engineering", Tata McGraw-Hill Education Education.
3. R., Reprint 2012
4. George Kennedy, "Electronic Communication Systems", McGraw Publication

Reference Books:

1. David A. Bell, "Electronic Devices and Circuits", Oxford University Press.
2. Jacob Millman, C.C. Halkias, StayabrataJit, "Electronic Devices and Circuits", McGraw Hill
3. David A. Bell, Electronic Instrumentation and Measurements, Latest Edition, Oxford Uni Press India

If the course is available as **Generic Elective**, then the students of following departments may opt it:
NO

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Physics of Class 12

Course Learning Outcomes:		
CO-1	Apply the fundamental laws of electricity and circuit analysis to solve basic AC/DC circuit problems.	**L2 & L3**
CO-2	**Analyze** DC circuits using Kirchhoff's laws, network theorems, and circuit simplification methods.	**L3 &L4**
CO-3	**Explain** the working of semiconductor devices and their applications in switching and amplification.	**L1& L3**
CO-4	**Demonstrate** the use of digital electronics concepts including number systems, logic gates, and basic combinational circuits.	**L2 & L3**
CO-5	**Recognize** modern electronic systems, IoT devices, and emerging technologies in computing and automation.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech CE/EE/ME**			**Year: I** **Semester: I/II**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENME-111/ENME-121**
4	**NA**	**Course Name**	**FUNDAMENTALS OF MECHANICAL AND MECHATRONICS SYSTEMS**

Course Objectives:

1. Introduce fundamental principles and theories in Mechanical Engineering.
2. Provide an overview of the historical development and current trends in Mechanical Engineering.
3. Familiarize students with basic engineering concepts such as forces, materials, structures, and systems relevant to both disciplines.
4. Develop problem-solving skills through practical applications and case studies in Mechanical Engineering contexts.
5. Cultivate an understanding of the interdisciplinary nature of Engineering and its impact on society and the environment.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	**T:** 1	**P:** 0	**C:** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**MATERIALS:** Classification of engineering material, Composition of Cast iron and Carbon steels, Iron Carbon diagram. Mechanical properties like strength, hardness, toughness, ductility, brittleness, malleability etc. of materials. Hooks law and modulus of elasticity, Hardness and Impact testing of materials, BHN etc.	**9L**
II	**Force Systems**: Basic concepts: Definitions, Basic assumptions, Scalar & Vector quantities, Classification of forces & Representation, Force as a Vector, Composition of forces, Parallelogram Law, Resolution, Principle of Transmissibility of forces **Coplanar Concurrent Force system and Coplanar:** Equilibrium of coplanar force system, Free body diagrams, Determination of reactions, Equilibrium of a body under three forces, Lami's theorem.	**9L**
III	**Introduction to mechanics of solid:** Normal and shear Stress, strain, Hookes' law, Poisson's ratio, elastic	**9L**

	constants and their relationship, stress-strain diagram for ductile and brittle materials, factor of safety. Basic Numerical problems. Types of beams under various loads.	
IV	**THERMODYNAMICS:** Thermodynamic system, properties, state, process, Zeroth, First and second law of thermodynamics, thermodynamic processes at constant pressure, volume, enthalpy & entropy. Steam Engineering: Classification and working of boilers, mountings and accessories of boilers, Efficiency.	**9L**
V	**Fundamental of Mechatronics:** Definition of Mechatronics, Sensors and Transducers: Definition, difference, classification, Actuators: Definition and Classification of Actuators Need and Scope, Programmable Logic Controller (PLC): Definition, PLC block diagram, Microcontroller: Comparison of Microprocessor and Microcontroller	**9L**

Text Books:
1. Nag P.K, Engineering Thermodynamics, TMH .
2. Agrawal C M, Basic Mechanical Engineering, Wiley Publication.

Reference Books:
1. Nag P.K, Engineering Thermodynamics , TMH .
2. Achuthan M, Engineering Thermodynamics, PHI. List of Suggestive
3. Ganesan, Internal Combustion Engines, TMH.
4. Textbook Of Mechatronics. R K Rajput

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand mechanical properties such as strength, hardness, toughness, ductility, brittleness, and malleability.	**L2 & L3**
CO-2	Understand the working principles of Lamis theorem	**L3 &L4**
CO-3	Understand steam engineering principles including boiler classification, mountings, accessories, and efficiency.	**L1& L3**
CO-4	Understand the concepts and purposes of various forces.	**L2 & L3**
CO-5	Understand about the basics of Mechatronics.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)												
CO-PO Mapping												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech CE/EE/ME**			**Year: I** **Semester: I**
Credits: 4		**Category**	**VAC**
Theory	**Practical**	**Course Code**	**ENCS-111**
4	**0**	**Course Name**	**Structured Programming and Problem Solving in C**

Course Objectives:

1. To understand the basics of computers, programming languages, the history and structure of the C language, and its compilation and execution process.
2. To learn to define problems, analyze them, and create solutions using algorithms, flowcharts, and pseudo code.
3. To gain proficiency in data types, variables, constants, literals, operators, expressions, and input/output functions in C.
4. To apply conditional statements, switch-case statements, looping structures, and functions, including recursion and library functions, in C programs.
5. To Work with arrays, strings, pointers, structures, unions, file handling, preprocessor directives, and advanced data structures, and solve real-world problems through case studies and project-based learning.

Nature of Paper: VAC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION TO PROGRAMMING AND PROBLEM SOLVING:** **INTRODUCTION TO COMPUTERS AND PROGRAMMING:** Overview of computers and programming languages, History and evolution of C language, Basic structure of a C program, Compilation and execution process. **PROBLEM SOLVING TECHNIQUES:** Problem definition and analysis, Algorithms and flowcharts, Pseudocode **FUNDAMENTALS OF C:** Data types and variables, Constants and literals, Operators and expressions, Input and output functions.	**9L**
II	**CONTROL STRUCTURES AND FUNCTIONS:** **CONTROL STRUCTURES:** Conditional statements (if, if-else, nested if), Switch-case statements, looping structures (for, while, do-while), Break and continue statements, **FUNCTIONS:** Function declaration and definition, Function calling and	**9L**

	parameter passing, Scope and lifetime of variables, Recursive functions, Library functions.	
III	**ARRAYS, STRINGS, AND POINTERS:** **ARRAYS:** One-dimensional arrays, Two-dimensional arrays, Multidimensional arrays, Array operations and applications, **STRINGS:** String handling functions, String manipulation techniques. **POINTERS:** Introduction to pointers, Pointer arithmetic, Pointers and arrays, Pointers to functions, Dynamic memory allocation.	**9L**
IV	**STRUCTURES, UNIONS, AND FILE HANDLING:** **STRUCTURES AND UNIONS:** Defining and declaring structures, Accessing structure members, Array of structures, Nested structures, Unions and their applications. **FILE HANDLING:** File operations (opening, closing, reading and writing), File modes, Sequential and random access files, Error handling in file operations.	**9L**
V	**ADVANCED TOPICS AND CASE STUDIES:** **PREPROCESSOR DIRECTIVES:** Macros, File inclusion, Conditional compilation. **ADVANCED DATA STRUCTURES:** Introduction to linked lists, Stacks and queues (concepts and basic operations). **PROBLEM SOLVING CASE STUDIES:** Real-world problem solving using C, Case studies and project-based learning, Debugging and testing techniques, Best practices in programming.	**9L**

Text Books:

1. *Computer Programming with C, Special Edition-MRCET, Mc Graw Hill Publishers 2017,*
2. *Computer Science: A Structured Programming Approach Using C, B, A, Forouzan and R, F, Gilberg, Third Edition, Cengage Learning,*

Reference Books:

1. *The C Programming Language, B, W, Kernighan and Dennis M, Ritchie, PHI*
2. *Computer Programming, E, Balagurusamy, First Edition, TMH*
3. *C and Data structures – P, Padmanabham, Third Edition, B, S, Publications,*

If the course is available as **Generic Elective**, then the students of following departments may opt it:
NO

Evaluation/Assessment Methodology

Category	Max, Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Students will demonstrate an understanding of the fundamentals of computers, and evolution of the C programming language, the basic structure of a C program, and the compilation and execution processes.	**L2 & L3**
CO-2	Students will be able to define and analyze programming problems, develop algorithms, create flowcharts, and write pseudo code to design effective solutions.	**L1,L2& L3**
CO-3	Students will gain proficiency in fundamentals of C and will be able to implement basic input and output functions.	**L1,L2& L3**
CO-4	Students will be able to apply conditional statements, switch-case statements, and looping structures to control program flow, and will understand function declaration, definition, calling, parameter passing, scope, lifetime of variables, and recursion.	**L2,L3 & L4**
CO-5	Students will demonstrate the ability to work with arrays, strings, and pointers, define and utilize structures and unions, perform file operations, and understand advanced data structures like linked lists, stacks, and queues. They will also be able to solve real-world problems using C.	**L2,L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	3	1	2	2	1	0	0	0	1	2	3
CO-2	3	2	3	2	1	1	0	0	0	1	1	1
CO-3	3	2	2	2	1	0	0	0	0	0	1	3
CO-4	2	3	3	2	2	1	0	0	0	1	2	2
CO-5	1	3	2	3	2	1	0	0	0	0	1	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech CE/EE/ME**			**Year: I** **Semester: I/II**
Credits: 4		**Category**	**AECC**
Theory	**Practical**	**Course Code**	**ENAS-114/ ENAS-124**
4	**NA**	**Course Name**	**Professional Communication and Digital fluency**

Course Objectives:

1. To understand and apply basic principles of professional communication, including the communication process and overcoming barriers.
2. To enhance the essentials of technical writing for engineering, including reports, documentation, professional emails, and proposals.
3. To gain confidence in public speaking, create effective presentations, and learn to engage different audiences.
4. To develop skills for building rapport, effective teamwork, conflict resolution, and leadership communication.
5. To learn to effectively use digital communication tools, social media, and adapt to emerging trends in global engineering contexts.

Nature of Paper: AECC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Fundamentals of Communication:** Definition and importance, Communication process, Verbal and non-verbal communication, Barriers to communication, Formal and informal communication.	**9L**
II	**Professional Speaking and Presentation Skills:** Public speaking, Group discussion, Effective oral communication, Use of visual aids, Body language, Elevator pitch, Presentation planning and delivery.	**9L**
III	**Business and Technical Writing:** Email etiquette, Resume and cover letter writing, Report writing, Technical documentation, Memos, Minutes of meetings.	**9L**
IV	**Digital Literacy and Collaboration Tools:** Digital platforms for communication (Zoom, Teams, Slack), Cloud collaboration (Google Docs, OneDrive), Etiquette of digital communication, Netiquette, Cyber safety.	**9L**
V	**Professionalism and Work Ethics:** Workplace behavior, Teamwork, Leadership communication, Conflict resolution, Time management, Building	**9L**

	online presence through LinkedIn and digital portfolios.	

Text Books and Reference Books:

1. *"Technical Communication: A Practical Approach" by William Sanborn Pfeiffer and Kaye E. Adkins*
2. *"The Essentials of Technical Communication" by Elizabeth Tebeaux and Sam Dragga*
3. *"Engineering Communication" by Charles W. Knisely and Karin I. Knisely*
4. *"Communicating in Groups: Applications and Skills" by Katherine Adams, Gloria Galanes, and Brandi R. Fritz*
5. *"Digital Communications: Fundamentals and Applications" by Bernard Sklar*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: English of Class 12

Course Learning Outcomes:

CO-1	Demonstrate effective communication skills, including verbal, non-verbal, and written, in professional engineering contexts.	**L2 & L3**
CO-2	Develop clear, concise, and coherent technical documents, including reports, project documentation, and professional emails.	**L3 &L4**
CO-3	Deliver engaging and informative oral presentations tailored to diverse audiences, utilizing effective visual aids and presentation techniques.	**L1& L3**
CO-4	Exhibit strong interpersonal and teamwork skills, including active listening, conflict resolution, and leadership communication.	**L2 & L3**
CO-5	Utilize digital communication tools and social media platforms to enhance professional networking and collaboration, adapting to emerging communication trends and global engineering contexts.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech (CSE/AI-ML)**			**Year: I** **Semester: I/II**
Credits: 5		**Category**	**AECC**
Theory	**Practical**	**Course Code**	**ENHU-112/ ENHU-122**
4	**1**	**Course Name**	**ENVIRONMENT, ECOLOGY AND SUSTAINIBILITY**

Course Objectives:

1. To introduce students to the interrelationship between humans and the environment, tracing historical, cultural, and ethical dimensions of sustainability.
2. To equip students with knowledge about natural resources, biodiversity, ecosystems, and their conservation strategies.
3. To raise awareness of major environmental issues local to global—such as pollution, climate change, land degradation, and disaster risk.
4. To familiarize students with environmental laws, policies, and international treaties related to environmental governance and sustainable development.
5. To encourage experiential learning through field visits, case studies, and hands-on campus environmental management activities.

Nature of Paper: AECC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)
50% Marks / 1 Credits

L : 3	**T :** 1	**P :** 3	**C :** 4+1

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Humans and the Environment:** The man-environment interaction: Humans as hunter-gatherers; Mastery of fire; Origin of agriculture; Emergence of city-states; Great ancient civilizations and the environment, Indic Knowledge and Culture of sustainability; Middle Ages and Renaissance; Industrial revolution and its impact on the environment; Population growth and natural resource exploitation; Global environmental change. **Environmental Ethics and emergence of environmentalism**: Anthropocentric and eco-centric perspectives (Major thinkers); The Club of Rome- Limits to Growth; UN Conference on Human Environment 1972; World Commission on Environment and Development and the concept of sustainable development; Rio Summit and subsequent international efforts.	**9L**
II	**Natural Resources and Sustainable Development**: Overview of natural resources: Definition of resource; Classification of natural resources-	**9L**

	biotic and abiotic, renewable and non-renewable. **Biotic resources**: Major type of biotic resources- forests, grasslands, wetlands, wildlife and aquatic (fresh water and marine); Microbes as a resource; Status and challenges. **Water resources**: Types of water resources- fresh water and marine resources; Availability and use of water resources; Environmental impact of over-exploitation, issues and challenges; Water scarcity and stress; Conflicts over water. **Soil and mineral resources**: Important minerals; Mineral exploitation; Environmental problems due to extraction of minerals and use; Soil as a resource and its degradation. **Energy resources**: Sources of energy and their classification, renewable and non-renewable sources of energy; Conventional energy sources- coal, oil, natural gas, nuclear energy; Non-conventional energy sources- solar, wind, tidal, hydro, wave, ocean thermal, geothermal, biomass, hydrogen and fuel cells; Implications of energy use on the environment. **Introduction to sustainable development**: Sustainable Development Goals (SDGs) - targets and indicators, challenges and strategies for SDGs.	
III	**Environmental Issues: Local, Regional and Global:** **Environmental issues and scales**: Concepts of micro-, meso-, synoptic and planetary scales; Temporal and spatial extents of local, regional, and global phenomena. **Pollution**: Impact of sectoral processes on Environment; Types of Pollution- air, noise, water, soil, thermal, radioactive; municipal solid waste, hazardous waste; transboundary air pollution; acid rain; smog. Land use and Land cover change: land degradation, deforestation, desertification, urbanization. Biodiversity loss: past and current trends, impact. **Global change**: Ozone layer depletion; Climate change. Disasters – Natural and Man-made	**9L**
IV	**Conservation of Biodiversity and Ecosystems:** Biodiversity and its distribution: Biodiversity as a natural resource; Levels and types of biodiversity; Biodiversity in India and the world; Biodiversity hotspots; Species and ecosystem threat categories. **Ecosystems and ecosystem services**: Major ecosystem types in India and their basic characteristics- forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services- classification and their significance. Threats to biodiversity and ecosystems: Land use and land cover change; Commercial exploitation of species; Invasive species; Fire, disasters and climate change. **Major conservation policies**: in-situ and ex-situ conservation approaches; Major protected areas; National and International Instruments for biodiversity conservation; the role of traditional knowledge, community-based conservation; Gender and conservation.	**9L**
V	**Environmental Pollution and Health: Understanding pollution: Production processes and generation of wastes; Assimilative capacity**	**9L**

	of the environment; Definition of pollution; Point sources and non-point sources of pollution. **Air pollution: Sources of air pollution; Primary and secondary pollutants; Criteria pollutants- carbon monoxide, lead, nitrogen oxides, ground-level ozone, particulate matter and sulphur dioxide; Other important air pollutants- Volatile Organic compounds (VOCs), Peroxyacetyl Nitrate (PAN), Polycyclic aromatic hydrocarbons (PAHs) and Persistent organic pollutants (POPs); Indoor air pollution; Adverse health impacts of air pollutants; National Ambient Air Quality Standards. Water pollution: Sources of water pollution; River, lake and marine pollution, groundwater pollution; water quality Water quality parameters and standards; adverse health impacts of water pollution on human and aquatic life.** **Soil pollution and solid waste: Soil pollutants and their sources; Solid and hazardous waste; Impact on human health.** **Noise pollution: Definition of noise; Unit of measurement of noise pollution; Sources of noise pollution; Noise standards; adverse impacts of noise on human health.** Thermal and Radioactive pollution: Sources and impact on human health and ecosystems.	
VI	**Climate Change: Impacts, Adaptation and Mitigation: Understanding climate change: Natural variations in climate; Structure of atmosphere; Anthropogenic climate change from greenhouse gas emissions– past, present and future; Projections of global climate change with special reference to temperature, rainfall, climate variability and extreme events; Importance of 1.5 °C and 2.0 °C limits to global warming; Climate change projections for the Indian sub-continent.** **Impacts, vulnerability and adaptation to climate change: Observed impacts of climate change on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests and natural ecosystems; Impacts on animal species, agriculture, health, urban infrastructure; the concept of vulnerability and its assessment; Adaptation vs. resilience; Climate-resilient development; Indigenous knowledge for adaptation to climate change.** **Mitigation of climate change**: Synergies between adaptation and mitigation measures; Green House Gas (GHG) reduction vs. sink enhancement; Concept of carbon intensity, energy intensity and carbon neutrality; National and international policy instruments for mitigation, decarbonizing pathways and net zero targets for the future; Energy efficiency measures; Renewable energy sources; Carbon capture and storage, National climate action plan and Intended Nationally Determined Contributions (INDCs); Climate justice.	**9L**

VII	**Environmental Management: Introduction to environmental laws and regulation: Constitutional provisions- Article 48A, Article 51A (g) and other derived environmental rights; Introduction to environmental legislations on the forest, wildlife and pollution control.** **Environmental management system: ISO 14001 Concept of Circular Economy, Life cycle analysis; Cost-benefit analysis Environmental audit and impact assessment; Environmental risk assessment Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability; Eco labeling /Eco mark scheme**	**9L**
VIII	**Environmental Treaties and Legislation**: An overview of instruments of international cooperation; bilateral and multilateral agreements; conventions and protocols; adoption, signature, ratification and entry into force; binding and non- binding measures; Conference of the Parties (COP) **Major International Environmental Agreements**: Convention on Biological Diversity (CBD); Cartagena Protocol on Biosafety; Nagoya Protocol on Access and Benefit-sharing; **Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES);** Ramsar Convention on Wetlands of International Importance; United Nations Convention to Combat Desertification (UNCCD); Vienna Convention for the Protection of the Ozone Layer; Montreal Protocol on Substances that Deplete the Ozone Layer and the Kigali Amendment; Basel Convention on the Control of Trans boundary Movements of Hazardous Wastes and their Disposal; Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade; Stockholm Convention on Persistent Organic Pollutants; Minamata Convention on Mercury; United Nations Framework Convention on Climate Change (UNFCCC); Kyoto Protocol; Paris Agreement; India's status as a party to major conventions **Major Indian Environmental Legislations**: The Wild Life (Protection) Act, 1972; The Water (Prevention and Control of Pollution) Act, 1974; The Forest (Conservation) Act, 1980; The Air (Prevention and Control of Pollution) Act, 1981; The Environment (Protection) Act, 1986; The Biological Diversity Act, 2002; The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006; Noise Pollution (Regulation and Control) Rules, 2000; Industry-specific environmental standards; Waste management rules; Ramsar sites; Biosphere reserves; Protected Areas; Ecologically Sensitive Areas; Coastal Regulation Zone; Status phase-out of production and consumption of Ozone Depleting Substances by India; National Green Tribunal; Some landmark Supreme Court judgements **Major International organizations and initiatives**: United Nations Environment Programme (UNEP), International Union for Conservation of Nature (IUCN), World Commission on Environment and Development (WCED), United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Panel on Climate Change	**9L**

	(IPCC), and Man and the Biosphere (MAB) programme.	
IX	**Case Studies and Field Work**: The students are expected to be engaged in some of the following or similar identified activities: 1. Discussion on one national and one international case study related to the environment and sustainable development. 2. Field visits to identify local/regional environmental issues, make observations including data collection and prepa re a brief report. 3. Participation in plantation drive and nature camps. 4. Documentation of campus biodiversity. Campus environmental management activities such as solid waste disposal, water Management and sanitation, and sewage treatment.	**9L**

Reference Books: Reference Books:

1. Fisher, Michael H. (2018) An Environmental History of India- From Earliest Times to the Twenty-First Century, Cambridge University Press.
2. Hedrick, Daniel R. (2020) Humans versus Nature- A Global Environmental History, Oxford University Press.
3. Hughes, J. Donald (2009) An Environmental History of the World- Humankind's Changing Role in the Community of Life, 2nd Edition. Routledge.
4. Perman, R., Ma, Y., Mc Gillivray, J., and Common, M. (2003) Natural Resource and Environmental Economics. Pearson Education.
5. Simmons, I. G. (2008). Global Environmental History: 10,000 BC to AD 2000. Edinburgh University Press
6. Chiras, D. D and Reganold, J. P. (2010). Natural Resource Conservation: Management for a Sustainable Future.10th edition, Upper Saddle River, N. J. Benjamin/Cummins/Pearson.
7. John W. Twidell and Anthony D. (2015). Renewable Energy Sources, 3rd Edition, Weir Publisher (ELBS)
8. William P.Cunningham and Mary A. (2015) Cunningham Environmental Science: A Global Concern, Publisher (Mc-Graw Hill, USA)
9. Gilbert M. Masters and W. P. (2008). An Introduction to Environmental Engineering and Science, Ela Publisher (Pearson)
10. Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications https://sdgs.un.org/goals
11. Harper, Charles L. (2017) Environment and Society, Human Perspectives on Environmental Issues 6th Edition. Routledge.
12. Harris, Frances (2012) Global Environmental Issues, 2nd Edition. Wiley- Blackwell.
13. William P. Cunningham and Mary A. (2015). Cunningham Environmental Science: A global concern, Publisher (Mc-Graw Hill, USA)
14. Manahan, S.E. (2022). Environmental Chemistry (11th ed.). CRC Press. https://doi.org/10.1201/9781003096238
15. Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press.
16. Bawa, K.S., Oomen, M.A. and Primack, R. (2011) Conservation Biology: A Primer for South Asia. Universities Press.
17. Sinha, N. (2020) Wild and Wilful. Harper Collins, India.
18. Varghese, Anita, Oommen, Meera Anna, Paul, Mridula Mary, Nath, Snehlata (Editors) (2022) Conservation through Sustainable Use: Lessons from India. Routledge.

19. Bhagwat, Shonil (Editor) (2018) Conservation and Development in India: Reimagining Wilderness, Earthscan Conservation and Development, Routledge.
20. Krishnamurthy, K.V. (2003) Textbook of Biodiversity, Science Publishers, Plymouth, UK
21. Jackson, A. R., & Jackson, J. M. (2000). Environmental Science: The Natural Environment and Human Impact. Pearson Education.
22. Masters, G. M., & Ela, W. P. (2008). *Introduction to environmental engineering and science* (No. 60457). Englewood Cliffs, NJ: Prentice Hall.
23. Miller, G. T., & Spoolman, S. (2015) Environmental Science. Cengage Learning.
24. Central Pollution Control Board Web page for various pollution standards. https://cpcb.nic.in/standards/
25. Ahluwalia, V. K. (2015). *Environmental Pollution, and Health*. The Energy and Resources Institute (TERI).
26. Pittock, Barrie (2009) Climate Change: The Science, Impacts and Solutions. 2nd Edition. Routledge.
27. www.ipcc.org; https://www.ipcc.ch/report/sixth-assessment-report-cycle/.
28. Adenle A., Azadi H., Arbiol J. (2015). Global assessment of technological innovation for climate change adaptation and mitigation in developing world, Journal of Environmental Management, 161 (15): 261-275.
29. Barnett, J. & S. O'Neill (2010). Maladaptation. Global Environmental Change—Human and Policy Dimensions 20: 211–213.
30. Berrang-Ford, L., J.D. Ford & J. Paterson (2011). Are we adapting to climate change? Global Environmental Change—Human and Policy Dimensions 21: 25-33.
31. Jørgensen, Sven Marques, Erik João Carlos and Nielsen, Søren Nors (2016) Integrated Environmental Management, A trans disciplinary Approach. CRC Press.
32. Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.
33. Barrow, C. J. (1999). Environmental management: Principles and practice. Routledge.
34. Tiefenbacher, J (ed.) (2022), Environmental Management - Pollution, Habitat, Ecology, and Sustainability, Intech Open, London. 10.5772/
35. Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.
36. UNEP (2007) Multilateral Environmental Agreement Negotiator's Handbook, University of Joensuu, ISBN 978-952-458-992-5
37. Ministry of Environment, Forest and Climate Change (2019) A Handbook on International Environment Conventions & Programmes. https://moef.gov.in/wp- content/uploads/2020/02/convention-V-16-CURVE-web.pdf
38. Kanchi Kohli and Manju Menon (2021) Development of Environment Laws in India, Cambridge University Press.
39. India Code – Digital repository of all Central and State Acts: https://www.indiacode.nic.in/Bohra, Saroj, Judicial Intervention and Evolution of Environmental Principles and Doctrines (January 7, 2019). Available at SSRN: https://ssrn.com/abstract=3311406 or http://dx.doi.org/10.2139/ssrn.3311406

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology	
Category	**Max. Marks**

1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Course Learning Outcomes:

CO1	Explain the evolution of human-environment interaction, environmental ethics, and sustainability principles.	L2
CO2	Classify natural resources and evaluate their usage, challenges, and conservation strategies.	L3
CO3	Analyze local, regional, and global environmental issues, including pollution, biodiversity loss, and land use change.	L4
CO4	Interpret the causes, consequences, and mitigation strategies of climate change and global environmental change.	L3
CO5	Describe key environmental policies, laws, and treaties at national and international levels.	L2

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO1	2	1	1	1	1	2	3	2	1	2	0	2
CO2	2	2	2	2	1	2	3	2	0	1	0	3
CO3	1	2	2	2	1	3	3	2	1	2	0	3
CO4	2	2	2	2	2	3	3	2	1	2	0	3
CO5	2	1	1	1	1	3	3	3	0	2	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech CE/EE/ME**			**Year: I** **Semester: I/II**
Credits: 2		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENAS-112P/ ENAS-122P**
NA	**2**	**Course Name**	**MODERN PHYSICS IN ENGINEERING LAB**

Course Objectives:
1. To understand the concept of wave length by the interference
2. To understand the concept of wave length by the diffraction.
3. To understand the concept of viscosity of liquid and flow of liquid
4. To understand the energy band gap in the semiconductors
5. To understand the concept of polarization

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	**T :** 0	**P :** 2	**C :** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	To determine the wavelength of Sodium light by Newton's rings
Practical-2.	To determine the wavelength of prominent lines of mercury by plane diffraction grating
Practical-3.	To determine the focus length combination of two lenses separated by distance and verify the formula for the focal length of combination of lenses
Practical-4.	To determine the wave length of sodium light with the help of Fresnel's bi-prism
Practical-5.	To determine the coefficient of viscosity of a given liquid
Practical-6.	To verify Stefan's law
Practical-7.	Calibration of a volt meter with potentiometer
Practical-8.	To determine the resistance per unit length and specific resistance of a given resistance using Carey Foster 's Bridge
Practical-9.	To determine the energy bend gap of a given semiconductor material
Practical-10.	To determine the Specific Rotation of the Cane sugar solution with the help of Polarimeter

Reference/Text Books:
1. *Practical Physics- K. K. Dey & B. N. Dutta (Kalyani Publishers New Delhi)*
2. *Engineering Physics- Practical- Katiyar&Pandey (Wiley India)*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	To determine the wavelength of sodium light by Newton's ring experiment	**L3**
CO-2	To determine the wavelength of sodium light with the help of Fresnel's bi-prism	**L3**
CO-3	To determine the viscosity of liquid.	**L3**
CO-4	To determine the emission of energy with respect the temperature and verify Stefan's law.	**L3 & L4**
CO-5	To determine the calibration of potential and draw the curve.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	2	0	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	2	2	1	0	0	0	0	0	0	2	2
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech CE/EE/ME**			**Year: I** **Semester: I/II**
Credits		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENAS-113P/ ENAS-123P**
NA	**2**	**Course Name**	**Engineering Chemistry Lab**

Course Objectives:
1. Student will be able to Estimate different impurities present in water sample.
2. Student will be able to Determine molecular properties such as surface tension, viscosity, pH, conductance and concentration of solution.
3. Student will be able to Identify iron concentration and percentage of available chlorine in supplied sample using titration methods

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	**T :** 0	**P :** 2	**C :** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	To determine total alkalinity in the given water sample.
Practical-2.	To determine the temporary and permanent hardness in water sample using EDTA as standard solution.
Practical-3.	To determine the available chlorine in bleaching powder solution.
Practical-4.	To determine the chloride content in the given water sample by Mohr's method.
Practical-5.	To determine the pH of the given solution using pH meter and pH-metric titration.
Practical-6.	To determine the Equivalent weight of Iron by the chemical displacement method.
Practical-7.	To determine the Viscosity of an addition polymer like polyester by Viscometer.
Practical-8.	To find chemical oxygen demand of waste water sample by potassium dichromate
Practical-9.	To determine the iron content in the given sample using external indicator
Practical-10.	To determine the strength of given HCL solution by titrating against N/10 Standard Sodium hydroxide solution

Reference/Text Books:
1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3)External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Estimate different impurities present in water sample.	**L4**
CO-2	Determine molecular properties such as surface tension, viscosity, pH, conductance and concentration of solution	**L3**
CO-3	Identify iron concentration and percentage of available chlorine in supplied sample using titration methods.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	0	2	1	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	3	3	1	0	0	0	0	0	0	2	1
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech CE/EE/ME**			**Year: I** **Semester: I/II**
Credits: 2		**Category**	**VAC**
Theory	**Practical**	**Course Code**	**ENCS-111P**
NA	**2**	**Course Name**	**PROGRAMMING WITH C LAB: HANDS ON LOGIC BUILDING**

Course Objectives:

1. To develop proficiency in implementing fundamental programming constructs such as loops, conditionals, functions, and arrays in C language through hands-on lab exercises.
2. To Gain practical experience in implementing and using data structures like arrays, linked lists, stacks, and queues to solve programming problems during lab sessions.
3. To Enhance problem-solving skills by applying algorithms learned in theory to practical programming tasks.
4. To engage in project-based learning activities where students work in teams to tackle larger programming projects.
5. To acquire skills in debugging and error handling techniques by identifying and resolving common programming errors encountered during lab exercises, ensuring robust and error-free code.

Nature of Paper: VAC (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	**T :** 0	**P :** 2	**C :** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Develop a program that performs basic arithmetic operations (addition, subtraction, multiplication, division) based on user input.
Practical-2.	Create a program to convert temperatures between Celsius, Fahrenheit, and Kelvin.
Practical-3.	Build a basic ATM simulation that allows users to check balance, deposit, and withdraw money.
Practical-4.	Develop a program to simulate a simple voting system with options and tallying votes.
Practical-5.	Create a program to calculate student grades based on user input of marks.
Practical-6.	Write a program that identifies whether a number is odd or even.
Practical-7.	Develop a program to check if a given year is a leap year.
Practical-8.	Create a program to solve quadratic equations.
Practical-9.	Implement a menu-driven program that performs different tasks like calculating area, volume, etc., based on user choice.

Practical-10.	Develop a recursive function to compute the factorial of a number.
Practical-11.	Develop a program to store and manipulate student marks using arrays. Calculate average, highest, and lowest marks.
Practical-12.	Implement a program to perform multiplication of two matrices.
Practical-13.	Create a function to reverse a string without using library functions.
Practical-14.	Write a program to dynamically allocate memory for an array and perform operations on it (e.g., finding the maximum element).
Practical-15.	Implement linear and binary search algorithms to find an element in an array
Practical-16.	Develop a program to check if a given string is a palindrome.
Practical-17.	Create a function that swaps two variables using pointers.
Practical-18.	Write a program to count the frequency of each character in a string.
Practical-19.	Develop a program to dynamically resize an array as elements are added or removed.
Practical-20.	Implement a function to concatenate two strings without using library functions.
Practical-21.	Create a program to manage employee records using structures.
Practical-22.	Implement a program to store and retrieve student details using file handling.
Practical-23.	Write a program to copy contents from one file to another.
Practical-24.	Create a payroll system that calculates and displays employee salaries, storing the data in files.
Practical-25.	Implement an inventory management system to track products using structures and file handling.
Practical-26.	Develop a program to manage patient records using structures and files.
Practical-27.	Create a program to demonstrate file error handling techniques.
Practical-28.	Write a program to generate student grade reports and save them in a file.
Practical-29.	Implement a singly linked list with operations like insertion, deletion, and traversal.
Practical-30.	Create a program to implement stack operations using arrays and linked lists.
Practical-31.	Develop a program to simulate a queue using arrays and linked lists.
Practical-32.	Write a program to count the number of words in a text file.
Practical-33.	Implement a program using macros for basic arithmetic calculations.
Practical-34.	Develop a program to recursively list all files in a directory (if operating system access is allowed).
Practical-35.	Implement a basic Sudoku solver using backtracking and recursion.
Practical-36.	Develop a comprehensive project simulating bank transactions including account creation, deposit, withdrawal, and balance inquiry, integrating structures, file handling, and dynamic memory allocation.

Text Books:

1. *Computer Programming with C, Special Edition-MRCET, Mc Graw Hill Publishers 2017,*
2. *Computer Science: A Structured Programming Approach Using C, B, A, Forouzan and R, F, Gilberg, Third Edition, Cengage Learning,*

Reference Books:

1. *The C Programming Language, B, W, Kernighan and Dennis M, Ritchie, PHI*
2. *Computer Programming, E, Balagurusamy, First Edition, TMH*
3. *C and Data structures – P, Padmanabham, Third Edition, B, S, Publications,*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Able to develop programs that perform fundamental arithmetic operations	**L2 & L3**
CO-2	Ale to use arrays, pointers, and structures by creating programs for matrix multiplication, student mark storage, employee records management, and dynamically resizing arrays	**L3 &L4**
CO-3	Able to implement recursive functions, linear and binary search algorithms	**L1& L3**
CO-4	will learn to manage data using file handling techniques, including storing and retrieving student details, copying file contents, generating grade reports, and handling file errors, essential for real-world applications	**L2 & L3**
CO-5	will apply their theoretical knowledge to practical, real-life scenarios, integrating multiple programming concepts seamlessly	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	1	0	0	0	1	2	3
CO-2	3	3	3	2	1	1	0	0	0	1	1	3
CO-3	3	3	3	3	1	0	0	0	0	0	1	3
CO-4	3	3	3	2	21	1	0	0	0	1	2	3
CO-5	3	3	3	3	2	1	0	0	0	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech** **CE/CSE/CSE(AIML)/EEE/ME**			**Year: I** **Semester: I/II**
Credits: 2		**Category**	**AECC**
Theory	**Practical**	**Course Code**	**ENAS-114P/ ENAS-124P**
NA	**2**	**Course Name**	**PROFESSIONAL COMMUNICATION LAB**

Course Objectives:

1. To enhance students' ability to communicate effectively in social and professional settings
2. To focus on the correct pronunciation and intonation patterns of English to ensure clear and understandable speech
3. To provide a solid foundation in English grammar and expand vocabulary for more accurate and expressive language use
4. To develop active listening skills and improve comprehension abilities through focused practice and exercises
5. To equip students with essential soft skills such as interview handling, email etiquette, and presentation skills to succeed in professional environments.

Nature of Paper: AECC (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment&50% of External Assessment)

L: 0	**T:** 0	**P:** 2	**C:** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	**Practical Title(English-Wordsworth-Language Lab)**
Module-1.	**Communication Skills –** 1. Social Meeting People & Asking Questions 2. Making Friends 3. Dos & Don'ts 4. What do you do?
Module-2.	**English Concepts –** 1. Tenses 2. Parts of Speech 3. Figures of Speech 4. Direct & Indirect Speech
Module-3.	**Pronunciation –** 1. Phonetics & Intonations 2. Vowels, Consonants, Nouns
Module-4.	**Communication Skills –** 1. Listening Skills

	2. Speaking Skills 3. Reading Skills 4. Writing Skills
Module-5.	**Advance Learning & Soft Skills –** 1. Effective Communication 2. Interview Handling Skills 3. Email Etiquette 4. Presentation Skills 5. Listening Comprehension

Text Books/Reference Books:

1. *Daniel Jones: English Pronouncing Dictionary*
2. *R.K. Bansal: Phonetics in English*
3. *Sethi and Dhamija: A Course in English Phonetics*
4. *S.D. Sharma: A Text-Book of Professional Communication & ESP*
5. *S.D. Sharma: Manual on Communication Lab English*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Students will demonstrate improved ability to meet and engage with people, make friends, and handle social interactions confidently and appropriately	**L2 & L3**
CO-2	Students will exhibit correct pronunciation, intonation, and the ability to articulate vowels, consonants, and nouns clearly	**L3 &L4**
CO-3	Students will show proficiency in using tenses, parts of speech, and figures of speech in both written and spoken English	**L1& L3**
CO-4	Students will display heightened listening skills and the ability to comprehend and respond accurately to spoken and written English	**L1 & L4**
CO-5	Students will be able to effectively manage interviews, compose professional emails, and deliver impactful presentations, showcasing their preparedness for professional scenarios	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	1	0	2	2	2	1	0	0	0	0	2	2

CO-2	1	3	2	2	2	1	0	0	0	0	1	2
CO-3	0	2	2	2	1	0	0	0	0	0	1	2
CO-4	1	3	2	2	2	0	0	0	0	0	1	1
CO-5	1	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech CE**			**Year: I** **Semester: I/II**
Credits: 2		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENEE-111P/ ENEE-121P**
NA	**2**	**Course Name**	**ELECTRONICS IN THE MODERN WORLD LAB**

Course Objectives:
1. To analyze a given network by applying various electrical laws.
2. To analyze a given network by applying various electrical network theorems
3. To know the response of electrical circuits for different excitations
4. To calculate, measure and know the relation between basic electrical parameters
5. To calculate, measure and know the relation between basic electronics parameters

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0	**T:** 0	**P:** 2	**C:** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Verification of Ohms Law.
Practical-2.	Verification of KCL and KVL for DC Circuits.
Practical-3.	Verification of Superposition Theorem.
Practical-4.	Verification of Thevenin`s Theorem
Practical-5.	Verification of Norton`s Theorem
Practical-6.	Verification of Maximum Power Transfer Theorem
Practical-7.	Calculations and Verification of Impedance and Current of RL, RC and RLC series Circuits.
Practical-8.	Measurement of Voltage, Current and Real Power in primary and Secondary AC Circuits
Practical-9.	The identification & Testing of Electronic component.
Practical-10.	Diode Characteristics(Si) a) Forward Bias b) Reverse Bias
Practical-11.	Study and analysis of half Wave rectifier with & without filter.
Practical-12.	Study and analysis of full Wave rectifier with & without filter.
Practical-13.	Transistor CE Characteristics (I/P & O/P)

Text Books:

1. Robert L. Boylestand / Louis Nashelsky "Electronic Devices and Circuit Theory", Pearson Education.
2. R. Muthusubramanian, S. Salivahanan, "Basic Electrical and Electronics Engineering", Tata McGraw-Hill Education, Reprint 2012
3. George Kennedy, "Electronic Communication Systems", McGraw Publication

Reference Books:

1. David A. Bell, "Electronic Devices and Circuits", Oxford University Press.
2. Jacob Millman, C.C. Halkias, StayabrataJit, "Electronic Devices and Circuits", McGraw Hill
3. David A. Bell, Electronic Instrumentation and Measurements, Latest Edition, Oxford Uni Press India

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Create basic electrical connections for domestic applications	**L2 & L3**
CO-2	Measure the various electrical parameters in the DC circuit	**L3 &L4**
CO-3	Measure the various electrical parameters in the AC circuit	**L1& L3**
CO-4	To study basic electronic components.	**L2 & L3**
CO-5	To get the practical expose of the Transistors applications.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	2	2	1	0	0	0	0	1	2
CO-3	3	3	2	2	1	0	0	0	0	0	1	2
CO-4	3	3	2	2	2	0	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech CE/EE/ME**			**Year: I** **Semester: I**
Credits: 2		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENME-123P**
NA	**2**	**Course Name**	**Introduction to CNC and 3-D Printer Lab**

Course Objectives:

1. Understanding CNC and 3D Printing Technologies
2. Gain hands-on experience with CNC machines and 3D printers, including setup, operation, maintenance, and troubleshooting.
3. Identify and select appropriate materials for CNC machining and 3D printing based on their properties and application requirements.
4. Apply quality control methods and standards to ensure the production of high-quality parts.\
5. Explore the diverse industry applications of CNC machining and 3D printing, including automotive, aerospace, healthcare, and consumer products

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	**T :** 0	**P :** 2	**C :** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	**Practical Title**
Practical-1.	Overview of CNC machine components and functions.
Practical-2.	Introduction to G-code and M-code.
Practical-3.	Writing simple CNC programs for basic shapes (e.g., square, circle).
Practical-4.	Loading and securing the workpiece along with tool selection and tool path setup.
Practical-5.	Programming and executing 2D milling operations to Creating a flat surface, slot, and pocket milling.
Practical-6.	Overview of CNC lathe operations along with programming and executing turning operations (e.g., facing, turning, threading).
Practical-7.	Introduction to CNC simulation software and Simulating CNC programs to verify tool paths and operations.
Practical-8.	Overview of 3D printing technology and applications along with Safety procedures and lab protocols.
Practical-9.	Understanding the parts of a 3D printer. With Basics of printer maintenance and troubleshooting. .
Practical-10.	Introduction to CAD software (e.g., Tinkercad, Fusion 360).

Practical-11.	Designing simple 3D models for printing.
Practical-12.	Introduction to slicing software (e.g., Cura, Prusa Slicer).
Practical-13.	Developing a small project that incorporates both CNC and 3D printing techniques

Reference/Text Books:

1. *"CNC Programming" S K Sinha*
2. *" Functional Design for 3D" by Mr Clifford T Smyth*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Understanding CNC and 3D Printing Technologies	**L2 & L3**
CO-2	Gain hands-on experience with CNC machines and 3D printers, including setup, operation, maintenance, and troubleshooting.	**L3 &L4**
CO-3	Understand the properties and selection criteria of various materials used in CNC machining and 3D printing	**L1& L3**
CO-4	Develop skills in designing 3D models suitable for CNC machining and 3D printing, including considerations for manufacturability and printability.	**L2 & L3**
CO-5	Understand quality control methods and standards for parts produced by CNC machining and 3D printing.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech CE/EE/ME**			**Year: I** **Semester: I/II**
Credits: 2		**Category**	**Core Lab**
Theory	**Practical**	**Course Code**	**ENME-112P/ENME-122P**
NA	**2**	**Course Name**	**Mechanical Workshop Lab**

Course Objectives:
1. To understand the importance of tools used in workshop.
2. To prepare various joints used in workshop.
3. To identify & apply the most appropriate tools for various applications.
4. To perform the various types of black smithy and sheet metal shop operations.
5. Introduce students to the fundamentals of Computer Numerical Control (CNC) machines, including their components, operation principles, and applications in modern manufacturing.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	**T :** 0	**P :** 3	**C :** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	**Practical Title**
Module-1	**Carpentry Shop:** **Practical-1:** To prepare half-lap corner joint. **Practical-2:** To prepare mortise & Tenon joint. **Practical-3:** To prepare a cylindrical pattern on woodworking lathe
Module-2	**Fitting Bench Working Shop:** **Practical-1:** To prepare a V-joint fitting **Practical-2:** To prepare a U-joint fitting **Practical-3:** To make a perfect square job
Module-3	**Black Smithy Shop:** **Practical-1:** To prepare a square rod from given circular rod. **Practical-2:** To prepare a square S- shape from given circular rod. **Practical-3:** To prepare a nail from given circular rod.
Module-4	**Welding Shop:** **Practical-1:** To prepare a butt welded joints using arc welding machine. **Practical-2:** To prepare a “T” welded joints using MIG welding machine. **Practical-3:** To prepare a Lap welded joint using resistance spot welding machine.
Module-5	**Sheet-metal Shop:** **Practical-1:** To make round duct of GI sheet using ‘soldering’ process. **Practical-2:** To prepare a tray of GI by fabrication

Module-6	**Machine Shop:** **Practical-1:** To prepare a bolt on the lathe machine as per given. Diagram. **Practical-2:** To prepare a slot on the horizontal milling machine as per given diagram.
Module-7	**Foundry Shop:** **Practical-1:** To prepare core as per given size. **Practical-2:** To prepare a mould for given casting.
Module-8	**CNC Shop:** **Practical-1:** Learn about the components of a CNC machine and their functions. **Practical-2:** Learn how to set up a workpiece in the CNC machine (fixturing, tooling, work holding). **Practical-3:** Understand the process of loading tools into the machine and tool length offsets. **Practical-4:** Mount the cutting tool on the tool post and set its position relative to the workpiece. **Practical-5:** To prepare a turning job on a CNC lathe machine according to a given diagram.

Reference/Text Books:

1. *A Course In Workshop Technology (Manufacturing Processes Vol. 1, B.S. Raghuwanshi, Publisher, Dhanpat Rai & Co.*
2. *Manufacturing Processes, Kumar & Gupta, Prentice Hall India.*
3. *Production Technology, Jain, Khanna Publications.*
4. *CNC Machining for Beginners by Paul Smith*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Understand the tools used in workshop & their applications.	**L2 & L3**
CO-2	Prepare various joints used in carpentry, fitting and welding shop.	**L3 &L4**
CO-3	Identify & apply the most appropriate tools for various manufacturing operations like turning, facing and threading.	**L1& L3**
CO-4	Perform the various types of black smithy and sheet metal shop operations.	**L2 & L3**
CO-5	Students will demonstrate proficiency in setting up CNC machines, loading programs, and executing machining operations to achieve specified dimensions and tolerances.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2

: Understand, L3 : Apply, L4 : Analyze)												
CO-PO Mapping												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	0	3	0	0	0	1	0	0	2	1
CO-2	0	3	3	3	0	1	3	1	1	1	2	1
CO-3	0	2	2	2	3	2	0	0	0	2	2	2
CO-4	0	2	2	1	2	1	0	0	0	0	3	1
CO-5	1	2	1	1	1	0	0	0	0	0	0	0

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech CE/EE/ME**			**Year: I** **Semester: I/II**
Credits: 2		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENME-113P/ ENME-123P**
NA	**2**	**Course Name**	**Engineering Graphics & Design Lab**

Course Objectives:
1. To study the standard and rules to be trailed by engineers for making precise drawings.
2. To understand the fundamental dimensioning practices that must be continued in the arrangement of drawings.
3. To draw the various types of projection of lines, planes and solids.
4. To apply the CAD for design.
5. To create the engineering models.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	**T :** 0	**P :** 2	**C :** 1

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Introduction to Engineering Drawing, Orthographic Projections: Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain and Diagonal Scales Principles of Orthographic Projections – Conventions – Projections of Points and Lines inclined to both planes; Projections of planes inclined Planes – Auxiliary Planes.
Practical-2.	Projections and Sections of Regular Solids: Sections in lined to both the Planes – Auxiliary Views; Simple annotation, dimensioning and scale. Floor plans they include: windows, doors. Prism, Cylinder, Pyramid, Cone – Auxiliary Views.
Practical-3.	Isometric Projections: Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conversions.
Practical-4.	Computer Graphics: Listing the computer technologies the impact on graphical communication, Demonstration knowledge of the theory of CAD software [such as: The Menu System, Tollbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects: Isometric Views of lines, Planes, Simple and compound Solids];

Practical-5.	Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen), Computer-aided design (CAD) software modeling of parts and assemblies.

Reference/Text Books:

1. *Engineering Drawing, Bhatt N.D., Panchal V.M. & Ingle P.R. (2014), Charotar Publishing House.*
2. *Engineering Drawing, Narayana, K.L. & P Kannaiah (2008), Scitech Publishers.*
3. *Engineering Drawing Paperback, P.S. Gill (Author) , S.K. Kataria & Sons.*
4. *Engineering Drawing and Computer Graphics, Shah, M.B. & Rana B.C. (2008), Pearson Education.*
5. *Engineering Graphics, Agrawal B. & Agrawal C.M. (2012), TMH Publication.*
6. *Engineering Graphics & Design, A.P. Gautametc, Khanna Publishing House.*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Understand the basic concepts and principles of engineering graphics and their significance.	**L2 & L3**
CO-2	Understand the theory of projections and regular solids.	**L3 &L4**
CO-3	Draw the various types of projection of lines, planes and solids.	**L1& L3**
CO-4	Apply the CAD for design.	**L2 & L3**
CO-5	Creating the engineering models using solid modeling.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	0	0	0	0	1	0	0	0	2	0	0
CO-2	3	2	0	0	0	1	0	0	0	0	0	0
CO-3	3	0	3	0	1	0	0	0	0	2	0	0
CO-4	2	0	2	0	3	0	0	0	0	1	0	0
CO-5	2	0	3	1	3	0	0	0	0	0	2	0

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech CE/EE/ME**			**Year: I** **Semester: II**
Credits: NC		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENPH-111**
NC	**NC**	**Course Name**	**SPIRITUAL AND CULTURAL HERITAGE: INDIAN EXPERIENCE**

Course Objectives:

1. To provide an overview of the foundations of Indian knowledge systems through the Vedas, Upanishads, epics, and traditional sciences.
2. To develop appreciation for India's rich heritage in art, architecture, literature, and languages.
3. To introduce the major Indian philosophical schools and contributions of spiritual thinkers.
4. To foster understanding of cultural identity and values rooted in Indian traditions
5. To highlight the modern relevance and global impact of Indian knowledge and heritage.

Nature of Paper: Audit Course (Lab)

Minimum Passing Marks/Credits: NC

L :	**T : 0**	**P :** 2	**C :** 0

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to Indian Knowledge Systems and Cultural Identity	**4L**
II	Vedas, Upanishads, Epics and Traditional Indian Sciences	**4L**
III	Art, Architecture, Literature and Languages of India	**4L**
IV	Indian Philosophical Schools and Spiritual Thinkers	**4L**
V	Modern Relevance and Global Impact of Indian Heritage	**4L**

Text Books:

1. The Essentials of Indian Philosophy by M. Hiriyanna. Motilal Banarsidass
2. Indian Philosophy by S. Radhakrishnan, Oxford University Press.
3. India: A Sacred Geography by Diana L. Eck. Three Rivers Press
4. The Wonder That Was India **by** A.L. Basham, Picador.
5. Cultural Heritage of India (Vols 1–5) by Ramachandra Rao, Bharatiya Vidya Bhavan

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	NA
2) Presentations /Seminar	25

3) Assignments	NA
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	NA
Total:	**NA**

Prerequisites for the course: NA

Course Learning Outcomes:

CO-1	Recognize the diversity and unity of Indian cultural traditions.	**L2 & L4**
CO-2	Understand the philosophical and spiritual essence of Indian scriptures.	**L3 &L4**
CO-3	Analyze the contributions of Indian heritage to global knowledge systems.	**L3 & L4**
CO-4	Appreciate art, literature, architecture and their cultural context.	**L2 & L3**
CO-5	Develop respect for Indian values, thought, and wisdom traditions.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	1	0	1	0	1	0	0	0	0	0	0	0
CO-2	0	1	1	1	1	1	0	0	0	0	0	0
CO-3	1	1	0	1	0	0	0	0	0	0	0	0
CO-4	0	0	0	1	1	1	0	0	0	0	0	0
CO-5	0	1	1	0	0	1	0	0	0	0	0	0

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**			**Year: I** **Semester: II**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENAS-121**
4	**NA**	**Course Name**	**APPLIED DIFFRENTIAL EQUATIONS**

Course Objectives:

1. To understand the effective mathematical tools for the solutions of differential equations that model physical processes.
2. To get the idea of types of partial differential equations and their solutions.
3. To understand the concept of Laplace Transform and its application to solve differential and integral equations.
4. To understand and apply the foundational knowledge and analytical skills of Fourier series in solving engineering problems.
5. To equip students with the knowledge and skills to formulate and solve linear programming problems for optimal decision-making in engineering applications.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**ORDINARY DIFFERENTIAL EQUATIONS:** Linear differential equation of nth order with constant coefficients, Simultaneous linear differential equations, Second order linear differential equations with variable coefficients, Solution by changing independent variable, Reduction of order, Normal form, Method of variation of parameters, Cauchy-Euler equation.	**9L**
II	**PARTIAL DIFFERENTIAL EQUATIONS:** Origin of Partial Differential Equations, Linear and Non Linear Partial Equations of first order, Lagrange's Equations, Charpit's method, Solution of Linear Partial Differential Equation of Higher order with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients.	**9L**
III	**LAPLACE TRANSFORM:** Laplace transform, Existence theorem, Laplace transforms of derivatives and integrals, Initial and final value theorems, Unit step function, Dirac- delta function, Laplace transform of periodic function, Inverse Laplace transform, Convolution theorem, Application to solve simple linear and simultaneous differential	**9L**

	equations.	
IV	**FOURIER SERIES:** Euler's Formulae, Functions having arbitrary periods,πPeriodic functions, Fourier series of period 2 Change of interval, Even and odd functions, Half range sine and cosine series.	**9L**
V	**Linear Programming and Optimization:** Definition and importance of Linear Programming in engineering and optimization, Real-life applications of Linear Programming in various fields, Formulation of Linear Programming Problems, Solution of Linear Programming Problems using the Graphical Method, Simplex Method, Concept of duality in Linear Programming, Dual Simplex Method.	**9L**

Text Books:

1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*
4. *S.D. Sharma, Operation Research, Kedar Nath Ram Nath Publications*

Reference Books:

1. *E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.*
2. *Veerarajan T., Engineering Mathematics for first year, McGraw-Hill, New Delhi, 2008.*
3. *R K. Jain & S R K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House 2002*
4. *H.A. Taha, Operation Research-An introduction, Printice Hall of India*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Engineering Mathematics-I (RTAS-111)

Course Learning Outcomes:

CO-1	to solve linear differential equations of nth order with constant coefficients, and apply methods to solve various types of differential equations including Cauchy-Euler equations.	**L2 & L4**
CO-2	to formulate and solve first and higher-order partial differential equations using methods like Lagrange's equations, Charpit's method	**L3 &L4**
CO-3	demonstrate proficiency in using Laplace transforms to solve differential equations using theorems related to initial and final values, convolution, and the inverse Laplace transform.	**L3 & L4**
CO-4	able to represent periodic functions using Fourier series, understand and apply	**L2 &**

	Euler's formulas, and construct Fourier series for functions of arbitrary periods and half-range expansions, identifying even and odd functions.	**L3**
CO-5	will develop the ability to formulate linear programming problems, solve them and understand the concept of duality in linear programming, with applications to real-life optimization problems in various fields.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	3	2	2	2	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	3	3	2	0	0	0	0	0	1	3
CO-4	3	3	2	3	2	1	0	0	0	0	1	2
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**			**Year: I** **Semester: II**
Credits: NC		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENHW-121**
NC	**NC**	**Course Name**	**HEALTH AND WELLNESS**

Course Objectives:

1. To introduce the concept and dimensions of health and wellness for a balanced lifestyle.
2. To develop awareness about nutrition, physical activity, and preventive measures against lifestyle diseases.
3. To promote mental and emotional well-being through stress management, mindfulness, and emotional intelligence.
4. To create awareness about substance abuse, its health risks, and strategies for prevention.
5. To educate students on public health practices, hygiene, first-aid, and digital wellness

Nature of Paper: Audit Course (Lab)

Minimum Passing Marks: NC

L :	**T : 0**	**P :** 2	**C :** 0

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to Health and Wellness: Definition and dimensions of health, importance of wellness, lifestyle diseases and their prevention.	**4L**
II	Nutrition and Physical Activity: Basics of a balanced diet, nutrients and their sources, physical activity guidelines, benefits of exercise and yoga.	**4L**
III	Mental and Emotional Well-being: Understanding stress, coping mechanisms, emotional intelligence, mindfulness practices, importance of sleep.	**4L**
IV	Substance Abuse and Health Risks: Awareness about tobacco, alcohol, drugs; addiction prevention; understanding peer pressure and making informed choices.	**4L**
V	Public Health and Digital Wellness: Hygiene and sanitation, preventive healthcare, first-aid basics, digital wellness, screen time management, online health resources.	**4L**

Text Books:

1. Textbook of Health and Physical Education by Dr. V.K. Sharma, Saraswati House
2. Health and Wellness by Dr. Anjali Arora. Penguin Books India
3. The Wellness Sense by Om Swami, Jaico Publishing House
4. Essentials of Physical Education by K. Goel, Goyal Brothers Prakashan

5. Fitness and Wellness by Wener W.K. Hoeger & Sharon A. Hoeger, Cengage Learning
If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology	
Category	**Max. Marks**
1) Class tasks/ Sessional Examination	NA
2) Presentations /Seminar	25
3) Assignments	NA
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	NA
Total:	**NA**

Prerequisites for the course: NA

Course Learning Outcomes:		
CO-1	Understand the importance of holistic health and identify factors affecting wellness.	**L2 & L4**
CO-2	Apply principles of nutrition and physical fitness for a healthy lifestyle.	**L3 &L4**
CO-3	Demonstrate awareness of mental and emotional health practices.	**L3 & L4**
CO-4	Recognize harmful substances and develop resistance to negative peer influence.	**L2 & L3**
CO-5	Practice good hygiene and digital wellness using available health resources.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	1	0	1	0	1	0	0	0	0	0	0	0
CO-2	0	1	1	1	1	1	0	0	0	0	0	0
CO-3	1	1	0	1	0	0	0	0	0	0	0	0
CO-4	0	0	0	1	1	1	0	0	0	0	0	0
CO-5	0	1	1	0	0	1	0	0	0	0	0	0

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**			**Year: I** **Semester: II**
Credits: 4		**Category**	**VAC**
Theory	**Practical**	**Course Code**	**ENCS-121**
4	**NA**	**Course Name**	**Fundamental Concepts and Problem Solving with Python**

Course Objectives:
1. To be able to introduce core programming basics.
2. To understand a range of Object-Oriented Programming, as well as in-depth data and information processing techniques.
3. To understand data types, statement, operators, modules, list, tuple, and dictionaries.

Nature of Paper: VAC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	**T:** 1	**P:** 0	**C:** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Python Programming:** History and evolution of Python, Features and advantages, Installation and setup (Python IDEs, Jupyter Notebook, Anaconda) **Basic Syntax:** Python syntax and semantics, Writing and executing a Python script, Indentation and code structure **Data Types and Variables:** Basic data types (int, float, str, bool), Variable declaration and assignment, Type conversion and casting **Operators and Expressions:** Arithmetic, relational, logical, and bitwise operators, Operator precedence and associativity.	**9L**
II	**Control Structures and Functions:** **Control Flow Statements:** Conditional statements (if, if-else, nested if-else), Looping statements (for, while, nested loops), Control statements (break, continue, pass), **Functions:** Defining and calling functions, Function arguments and return values, Recursion, Lambda functions and anonymous functions, **Modules and Packages:** Importing modules and using standard libraries, Creating and using custom modules, Introduction to virtual environments	**9L**
III	**Data Structures in Python:** **Strings:** String operations and methods, String formatting and manipulation, **Lists:** List operations and methods, List comprehensions, Nested lists,	**9L**

	Tuple: Tuple operations and methods, Advantages of using tuples, **Dictionaries:** Dictionary operations and methods, Dictionary comprehensions, Nested dictionaries, **Sets:** Set operations and methods, Set theory operations (union, intersection, difference)	
IV	**Problem Solving and File Handling:** **Problem Solving Techniques:** Algorithm design and pseudo code, Flowcharts, Debugging and testing, Exception handling (try, except, finally) **File Handling:** Reading from and writing to files, File methods and operations (open, close, read, write, append), Working with CSV and JSON files **Regular Expressions:** Introduction to regular expressions, Using the **re** module for pattern matching	**9L**
V	**Advanced Topics and Future Technologies:** **Object-Oriented Programming (OOP):** Classes and objects, Inheritance, polymorphism, encapsulation, and abstraction, Magic methods and operator overloading **Introduction to Data Science:** Basics of NumPy and Pandas, Data analysis and manipulation, Visualization with Matplotlib and Seaborn. **Future Prospects:** Career opportunities and industry trends, Ethical considerations in technology	**9L**

Text Books:

1. *Python Crash Course.*
2. *Head-First Python, 2nd edition*

Reference Books:

1. *Guido van Rossum, and Fred L. Drake, Jr. (Editor)ISBN: 1906966141*
2. *Network Theory Ltd, 120 pages (Revised November 2006)*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	**Max. Marks**
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: solid computer literacy.

Course Learning Outcomes:

CO-1	To define the structure and components of a Python program.	**L2 & L3**
CO-2	To learn how to build and package Python modules for reusability.	**L3 &L4**
CO-3	To learn how to write functions and pass arguments in Python.	**L1& L3**

CO-4	To learn how to read and write files in Python.	**L2 & L3**
CO-5	To learn how to design object-oriented programs with Python classes.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	1	0	3	0	0	0	0	0	0	1
CO-2	3	2	2	0	3	0	0	0	0	0	1	2
CO-3	3	3	2	0	3	0	0	0	0	0	0	2
CO-4	3	3	1	0	3	0	0	0	0	0	1	2
CO-5	3	3	3	0	3	2	0	0	0	0	2	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**			**Year: I** **Semester: II**
Credits: 2		**Category**	**VAC**
Theory	**Practical**	**Course Code**	**ENCS-121P**
NA	**2**	**Course Name**	**Fundamental Concepts and Problem Solving with Python Lab**

Course Objectives:

1. Develop proficiency in writing and executing basic Python programs
2. Implement core programming concepts including conditional statements, loops, and functions through practical tasks
3. Enhance problem-solving skills by tackling tasks such as swapping values without a third variable
4. Gain a strong grasp of data structures like lists, tuples, and dictionaries, and practice algorithms for operations like merging sorted lists, removing duplicates, and counting specific elements
5. Explore advanced Python features and libraries by creating classes, utilizing random functions

Nature of Paper: VAC (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment&50% of External Assessment)

L: 0	**T:** 0	**P:** 2	**C:** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Write a Python program to print "Hello, World!".
Practical-2.	Implement a calculator that can perform addition, subtraction, multiplication, and division.
Practical-3.	Determine if a given year is a leap year.
Practical-4.	Swap the values of two variables without using a third variable.
Practical-5.	Check if a given string is a palindrome.
Practical-6.	Determine the maximum of three given numbers.
Practical-7.	Check if a number is an Armstrong number.
Practical-8.	Merge two sorted lists into a single sorted list.
Practical-9.	Remove duplicate elements from a list.
Practical-10.	Python program to count positive and negative numbers in a list.
Practical-11.	Python Program to Accept the Strings Which Contains all Vowels.
Practical-12.	Write a python Programming to find Maximum record value key in dictionary
Practical-13.	Python program to find tuple which have all elements divisible by K from a list of tuple

Practical-14.	Write a Python program to create a calculator class. Include methods for basic arithmetic operations.
Practical-15.	Write a Python function to find the maximum of three numbers.
Practical-16.	Write a Python program to select a random element from a list, set, dictionary-value, and file from a directory. Use random. Choice().
Practical-17.	Write a Python program to check if a function is a user-defined function or not. Use types. Function Type, types. Lambda Type().

Reference/Text Books:

- *Guido van Rossum, and Fred L. Drake, Jr. (Editor)ISBN: 1906966141*
- *Network Theory Ltd, 120 pages (Revised November 2006)*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	To Understand basic syntax of python implementation	**L2 & L3**
CO-2	To practically apply looping and conditional constructs	**L3 &L4**
CO-3	To implement program related with list data structure	**L1& L3**
CO-4	To implement various searching algorithm in python	**L2 & L3**
CO-5	To implement list, tuple, dictionary and modules	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	1	2	1	3	1	1	1	1	1	1	1
CO-2	3	2	2	2	3	1	1	1	2	1	1	2
CO-3	3	3	2	2	3	1	1	1	2	1	1	2
CO-4	3	2	2	2	3	1	1	1	2	1	1	2
CO-5	3	2	2	3	3	1	1	1	2	1	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech CE/EE/ME**			**Year: I** **Semester: II**
Credits: 2		**Category**	**Lab**
Theory	**Practical**	**Course Code**	**SPT-PC-111**
NA	**2**	**Course Name**	**Sports**

Course Objectives: The objectives of studying this course are

1. To develop students' physical fitness, mental well-being, and proficiency in various individual and team sports through structured participation and practice.
2. To foster qualities of discipline, teamwork, sportsmanship, and strategic thinking by engaging students in competitive and recreational games and physical activities.

Nature of Paper: Core (Practical)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 0	**T:** 0	**P:** 2	**C:** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

No	Contents	No. of Lectures Allotted
1	Archery/ Athletics/ Badminton/ Basketball/ Boxing/ Carrom/ Chess/ Cricket/ Football/ Handbal/l Judo/ Kabaddi/ Kho-Kho/ Martial Arts/ Powerlifting/ Table/ Tennis/ Volleyball/ Weightlifting/ Wrestling/ Yoga.	**2L**

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	15
2) Presentation/Seminar/Viva-Voce(Internal)		-
3) External Practical Assessment	External Assessment	35
4) Presentation/Seminar/Viva-Voce(External)		-
5) Practical Records		-
Total:		**50**

Prerequisites for the course: NA

Course Learning Outcomes:

CO-1	Demonstrate basic skills, rules, and techniques required for effective participation in individual sports such as athletics, archery, boxing, and martial arts.	**L3**

CO-2	Exhibit proficiency in team-based sports like football, basketball, volleyball, kabaddi, and kho-kho, with emphasis on coordination, communication, and team strategy	**L3, L4**
CO-3	Analyze and apply rules, scoring systems, and tactics in indoor games such as chess, carrom, and table tennis to enhance cognitive and decision-making skills.	**L4**
CO-4	Develop and maintain physical fitness, flexibility, and endurance through regular practice and participation in strength-based and aerobic activities such as yoga, powerlifting, and athletics	**L3**
CO-5	Demonstrate sportsmanship, ethical behavior, self-discipline, and leadership qualities both during practice and competitive events.	**L3,L5**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	2	1	2	1	1	–	–	–	2	1	–	2
CO-2	–	1	2	–	–	–	–	–	3	2	2	2
CO-3	1	2	–	–	1	–	–	2	2	2	–	2
CO-4	–	–	–	2	–	–	2	–	1	1	–	3
CO-5	–	–	–	–	–	3	–	3	3	2	3	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech. CE**			**Year: II** **Semester: III**
Credits: 4		**Category**	**Core 7**
Theory	**Practical**	**Course Code**	**RTAS-231**
4	**NA**	**Course Name**	**Engineering Mathematics-III**

Course Objectives:
1. To make the students familiar with complex functions and its calculus.
2. To deal with applications, residues, and conformal mapping.
3. To understand the concept and applications of integral transforms.
4. To deal with numerical solutions of algebraic equations and differential equations.
5. To understand the statistical aspect of functions.

Nature of Paper: Applied Science Courses(Core)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	**T:** 1	**P:** 0	**C:** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Functions of a Complex Variable I**: Analytic functions; C-R equations and harmonic functions; Line integral in the complex plane; Cauchy's integral theorem, Cauchy's integral formula for derivatives of analytic functions; Liouville's theorem.	**9L**
II	**Functions of a Complex Variable II**: Representation of a function by power series; Taylor's andLaurent's series; Singularities, zeroes, and poles; Residue theorem, evaluation of real integrals; conformal mapping and bilinear transformations.	**9L**
III	**Integral Transforms:** Fourier integral, Fourier complex transform, Fourier sine and cosine transforms and applications to simple heat transfer equations. Z – Transform and its application to solve difference equations.	**9L**
IV	**Numerical Techniques:** Solution of polynomial and transcendental equations Bisection method, RegulaR – Falsi method, Newton - Raphson method. **Interpolation:** Finite difference, Newton's forward and backward interpolation, Lagrange's and Newton's divided difference formula for unequal intervals; **Numerical Differentiation**, **Numerical Integration**: Trapezoidal, Simpson's 1/3 and 3/8 rules.	**9L**

	Numerical solutions of first order differential equations by Euler's method and 4th order Runge-Kuttamethod.	
V	**Statistical Techniques:** Moments, Moment generating functions, Skewness, Kurtosis, CurveFitting and Solution of Equations: Method of least squares and curve fitting of straight line and parabola, Correlation and Regression, Binomial distribution, Poisson distribution, Normal distribution.	**9L**

Text Books:

1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*

Reference Books:

1. *E. Kreyszig, Advance Engineering Mathematics, John Wiley & Sons, 2005.*
2. *R K. Jain & S R K. Iyenger, Advance Engineering Mathematics, Narosa Publishing House 2002.*
3. *Veerarajan T., Engineering Mathematics for first year, McGraw-Hill, New Delhi, 2008.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Engineering Mathematics-I (SEAS-111) & Engineering Mathematics-II (SEAS-121)

Course Learning Outcomes:

CO-1	Understand and check the Analyticity of a complex function.	**L2 & L3**
CO-2	To apply the concept of Analytic functions in residue and conformal mappings.	**L3 &L4**
CO-3	To solve and apply the concepts of transforms in the area of engineering.	**L1& L3**
CO-4	To solve numerically the Algebraic equations, Differential equations, and to differentiate & integrate numerically.	**L2 & L3**
CO-5	To understand and use the concept of statistical tools to analyze the different data.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Engineering Mathematics-III(RTAS-231)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	0	0	0	2	2

CO-2	1	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	2	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech CE**			**Year: II** **Semester: III**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**RESE-232/ RESE-242**
4	**NA**	**Course Name**	**Environmental Law and Policy**

Course Objectives:
1. To explain the role of law, policy and institutions in the conservation and management
2. To introduce the laws and policies both at the national and international level relating
3. To equip the students with the skills needed for interpreting laws, policies and judicial decisions

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**UNIT-I** An introduction to the legal system; Constitution, Acts, Rules, Regulations; Indian Judiciary, Doctrine of precedents, judicial review, Writ petitions, PIL– liberalization of the rule of locus standi, Judicial activism. Introduction to environmental laws in India; Constitutional provisions, Stockholm conference; Bhopal gas tragedy; Rio conference. General principles in Environmental law: Precautionary principle; Polluter pays principle; Sustainable development; Public trust doctrine, Overview of legislations and basic concepts	**9L**
II	**UNIT-II** Wildlife and Biodiversity related laws: Evolution and Jurisprudence of Forest and Wildlife laws; Colonial forest policies; Forest policies after independence Statutory framework on Forests, Wildlife and Biodiversity: IFA, 1927; WLPA, 1972; FCA, 1980; Biological Diversity Act, 2002; Forest Rights Act, 2006. Strategies for conservation–Project Tiger, Elephant, Rhino, Snow leopard.	**9L**
III	**UNIT-III** Air, Water and Marine Laws: National Water Policy and some state policies Laws relating to prevention of pollution, access and management of water and institutional mechanism: Water Act, 1974; Water Cess Act, 1977, EPA, 1986. Pollution Control Boards Ground water and law Judicial remedies and procedures Marine laws of India; Coastal zone regulations. Legal framework on Air pollution: Air Act,1981; EPA, 1986	**9L**

IV	**UNIT-IV** Environment protection laws and large ProjectsLegal framework on environment protection-Environment Protection Act as the framework legislation–strength and weaknesses; EIA; National Green tribunal The courts infrastructure projects.	**9L**
V	**UNIT-V** Hazardous Substances and Activities Legal framework: EPA and rules; PLI Act, 199 Principles of strict and absolute liability. An introduction to International law; sources of international law; law of treaties; signature, ratification Evolution of international environmental law: Customary principles; Common but differentiated responsibility, Polluter pays	**9L**

Text Books:

1. Birnie P. (2009) et al., International Law and the Environment, 3rd ed., Oxford.
2. Leelakrishnan P. (2006) Environmental Law Case Book, 2nd ed, Lexis Nexis, India.

Reference Books:

1. Sands P. (2002) Principles of International Environmental Law, 2nd ed, Cambridge

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	Be familiar with the laws in the field of environment	**L1 & L2**
CO-2	Be familiar with the institutions in the field of environment	**L1 &L2**
CO-3	Be familiar with the institutions in the field of environment	**L1& L3**
CO-4	Acquire the skills needed for interpreting laws, policies and judicial decisions in a holistic perspective	**L2 & L3**
CO-5	Acquire the ability to evaluate the role of law and policy in conservation and management of natural resources and prevention of pollution	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

Environmental Law and Policy **I(**RESE-232/ RESE-242**)**

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	2	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech CE**			**Year: II** **Semester: III**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**RESE-231/ RESE-241**
4	**NA**	**Course Name**	**Introduction to Construction Material**

Course Objectives:
1. To give introduction to the basic materials such as lime, mud, stone, brick, bamboo, thatch, straw and timber.
2. To give knowledge about construction using basic materials in simple situations
3. To facilitate in the design of buildings using a combination of the basic materials.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Aggregate: Classification, Physical and mechanical properties, soundness, alkali-aggregate reaction, thermal properties of aggregate Bricks and Masonry Blocks: Types, properties and field and laboratory tests to evaluate quality Lime: classification, properties Cement: types, Portland cement: chemical composition of raw material, bogue compounds, hydration of cement, role of water in hydration, testing of cements, fly ash: properties and use in manufacturing of bricks and cement.	**9L**
II	Mortar: Types and tests on mortars. Concrete: Production, mix proportions and grades of concrete, fresh, mechanical and durability properties of concrete, factors affecting properties of concrete, tests on concrete, admixtures,	**9L**
III	Special concrete: light weight concrete, high density concrete, vacuum concrete, shotcrete, steel fiber reinforced concrete, polymer concrete, Ferro cement, high performance concrete, self-compacting concrete.	**9L**
IV	Building stone: classifications, properties and structural requirements; Wood and Wood products: Introduction to wood macrostructure, sap wood and heart wood, defects and decay of timber, seasoning and preservation of timber, fire resisting treatment, introduction to wood products- veneers, plywoods, fibre board, particle board, block board, batten boards.	**9L**
V	Metals: Steel: Important properties and uses of Iron (Cast iron, wroght	**9L**

	iron and steel), Important tests on steel rebar, aluminum and copper. Glass: types and uses, gypsum: source, properties, uses; plastic: properties and uses, paint: types, distemper, varnish, Adhesive: Types, Bitumen: types, properties and tests.	

Text Books:
1. A Text-Book of Building Construction, S.P.Bindra and S.P.Arora, Dhanpat Rai Publications
2. Building Construction, by B. C. Punmia, , Laxmi Publicaton
3. Building Materials and Building Construction, by P C Verghese

Reference Books:
1. Building Materials and Construction, Jena and Sahu, Mc. Graw Hill.
2. Materials for Civil and Construction Engineers, Mamlouk and Zaniewski, Pearson

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	Identify relevant type of construction materials for the given type of building.	**L1 & L2**
CO-2	Use the relevant type of special purpose construction materials in the given situation	**L2 &L3**
CO-3	Undertake the given type of building construction activity for the given component of building structure	**L1& L3**
CO-4	Design the relevant means of communication for the given building structure.	**L2 & L3**
CO-5	Use the relevant type of material for finishing purpose in the given situation.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Introduction to Construction Material **I**(RESE-231/ RESE-241)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	2	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech. CE**			**Year: II** **Semester: III**
Credits: 4		**Category**	**Core 7**
Theory	**Practical**	**Course Code**	**RESE-233**
4	**NA**	**Course Name**	**Introduction to A.I.**

Course Objectives:

1. Understand the various characteristics of intelligent agents.
2. Learn the different search strategies in AI.
3. Learn to represent knowledge in solving AI problems.
4. Understand the different ways of designing software agents and know about the various applications of AI.
5. To develop semantic-based and context-aware systems to acquire, organize process, share and use the knowledge embedded in multimedia content.

Nature of Paper: Engineering Science Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.	**9L**
II	**Introduction to Search:** Searching for solutions, Uniformed search strategies, Informed search strategies, Local search algorithms and optimistic problems, Adversarial Search, Search for games, Alpha - Beta pruning.	**9L**
III	**Knowledge Representation & Reasoning:** Propositional logic, Theory of first order logic, Inference in First order logic, Forward & Backward chaining, Resolution, Probabilistic reasoning, Utility theory, Hidden Markov Models (HMM), Bayesian Networks	**9L**
IV	**Planning and Learning:** Planning with state space search, conditional planning, continuous planning, Multi-Agent planning. Forms of learning, Inductive Learning, Statistical learning method and Reinforcement learning.	**9L**
V	**Expert systems:-** Introduction, basic concepts, structure of expert systems, the human element in expert systems how expert systems works, problem areas addressed by expert systems, expert systems success	**9L**

	factors, types of expert systems, expert systems and the internet interacts web, knowledge engineering, scope of knowledge, difficulties, in knowledge acquisition methods of knowledge acquisition, machine learning, intelligent agents, selecting an appropriate knowledge acquisition method, societal impacts reasoning in artificial intelligence, inference with rules, with frames: model based reasoning, case based reasoning, explanation & meta knowledge inference with uncertainty representing uncertainty.	

Text Books:

1. *S. Russel and P. Norvig, "Artificial Intelligence – A Modern Approach", SecondEdition, Pearson Education.*
2. *David Poole, Alan Mackworth, Randy Goebel, "Computational Intelligence : a logical approach", Oxford University Press.*

Reference Books:

1. *G. Luger, "Artificial Intelligence: Structures and Strategies for complex problemsolving", Fourth Edition, Pearson Education.*
2. *J. Nilsson, "Artificial Intelligence: A new Synthesis", Elsevier Publishers.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Build intelligent agents for search and games.	**L3**
CO-2	Solve AI problems through programming with Python.	**L2& L3**
CO-3	Learn optimization and inference algorithms for model learning.	**L2 & L3**
CO-4	Design and develop programs for an agent to learn and act in a structured environment.	**L3& L4**
CO-5	Possess the ability to apply AI techniques to solve problems of Game Playing, Expert Systems and machine learning.	**L3& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Introduction to A.I. (RESE-233)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech. CE**			**Year: II** **Semester: III**
Credits: 4		**Category**	**Core 7**
Theory	**Practical**	**Course Code**	**RESE-234**
4	**NA**	**Course Name**	**Soft Computing**

Course Objectives:
1. To introduce the concept of soft computing.
2. To acquaint the concept of Fuzzy System.
3. To understand the concepts of Neuro-fuzzy Modeling.
4. To introduce the concept of genetic algorithms.
5. To understand the applications of soft computing and to introduction MATLAB Environment.

Nature of Paper: Engineering Science Elective

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Unit	Unit
I	Introduction to Soft Computing, ARTIFICIAL NEURAL NETWORKS Basic concepts - Single layer perception - Multilayer Perception - Supervised and Unsupervised learning – Back propagation networks - Kohnen's self-organizing networks - Hopfield network.	**9L**
II	FUZZY SYSTEMS Fuzzy sets, Fuzzy Relations and Fuzzy reasoning, Fuzzy functions - Decomposition - Fuzzy automata and languages - Fuzzy control methods - Fuzzy decision making.	**9L**
III	NEURO - FUZZY MODELING Adaptive networks based Fuzzy interface systems - Classification and Regression Trees - Data clustering algorithms - Rule based structure identification - Neuro-Fuzzy controls - Simulated annealing – Evolutionary computation	**9L**
IV	GENETIC ALGORITHMS Survival of the Fittest - Fitness Computations - Cross over - Mutation - Reproduction - Rank method - Rank space method	**9L**
V	APPLICATION OF SOFT COMPUTING Optimization of traveling salesman problem using Genetic Algorithm, Genetic algorithm based Internet Search Techniques, Soft computing based hybrid fuzzy controller, Introduction to MATLAB Environment for Soft computing Techniques.	**9L**

Text Books:
1. *An Introduction to Genetic Algorithm Melanic Mitchell (MIT Press)*
2. *Evolutionary Algorithm for Solving Multi-objective, Optimization Problems (2nd Edition), Collelo,*

Lament, Veldhnizer (Springer)
3. *Fuzzy Logic with Engineering Applications Timothy J. Ross (Wiley)*

Reference Books:
1. *Neural Networks and Learning Machines Simon Haykin (PHI)*
2. *Sivanandam, Deepa, " Principles of Soft Computing", Wile.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Fuzzy Logic

Course Learning Outcomes:

CO-1	To memorize and understand the concept of soft computing.	**L2 & L3**
CO-2	To understand the fundamentals of Neuro-fuzzy Modeling	**L3 &L4**
CO-3	To understand the concept of genetic algorithms.	**L1& L3**
CO-4	To understand the concept of genetic algorithm based Internet Search Techniques.	**L2 & L3**
CO-5	To memorize and understand the concept of applications of soft computing	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Soft Computing (RESE-234)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	1	0	2	2	2
CO-2	1	3	2	3	2	1	0	2	0	2	1	2
CO-3	2	2	0	1	1	0	0	1	0	3	1	2
CO-4	3	1	2	3	2	1	0	1	0	2	1	1
CO-5	2	2	2	2	2	1	0	3	0	3	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Programme: UG(R) **Class: B-Tech CE**			**Year: II** **Semester: III**
Credits: 4		**Category**	**ESE**
Theory	**Practical**	**Course Code**	**RESE-235/ RESE-245**
4	**NA**	**Course Name**	**Introduction to IOT**

Course Objectives:
1. To learn the fundamentals of Internet of Things
2. To understand IoT Reference Architecture and basics of IoT protocols
3. To apply the concept of Internet of things in the real world scenario

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION AND APPLICATIONS** Introduction to IoT–Definition, Characteristics, functional requirements, motivation, Physical design-things in IoT, IoT protocols, Logical Design-functional blocks, communication models, Communication APIs, Applications–Home Automation, Cities, Environment, Energy, Agriculture, Health, Industry.	**9L**
II	**M2M AND SYSTEM MANAGEMENT** Introduction-M2M, Difference between M2M and IoT, SDN and NFV for IoT, System Management–need, SNMP, NETCONF, YANG	**9L**
III	**DEVELOPING INTERNET OF THINGS** IoT Methodology-Purpose & Requirements specification, process specification, domain model specification, information model specification, service specification, IoT level specifications.	**9L**
IV	**USAGE OF PYTHON** IoT systems logical design using python-python data types & data structures, control flow, functions or modules, remote access enablement using cloud	**9L**
V	**CASE STUDY ON IoT SYSTEM** Case study for weather monitoring system-modules & package of python, python packages of interest for IoT-JSON, XML, HTTP & URLLib, SMTPLib. Exemplary device-Rasberry pi, Linux on Raspberry pi.	**9L**

Text Books:

1. *Dr. Ovidiu Vermesan and Dr. Peter Friess, Internet of Things: From research and innovation to market deployment, River Publishers 2014.*
2. *Honbo Zhou,"The Internet of Things in the Cloud: A Middleware Perspective" - CRC Press 2012.*
3. *Arshdeep Bahga and Vijay Madisetti, Internet of Things A Hand-on Approach, Universities press, 2015*

Reference Books:

1. *Dieter Uckelmann et.al, Architecting the Internet of Things, Springer, 2011*
2. *Pethuru Raj and Anupama C.Raman, "The Internet of Things: Enabling Technologies and Use Cases, CRC Press*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Basics of programming language

Course Learning Outcomes:

CO-1	Explain the fundamentals of IoT and its applications.	**L2**
CO-2	Illustrate applications of IoT in real time scenario.	**L2 & L3**
CO-3	Interpret M2M and IoT system management	**L2 & L3**
CO-4	Discuss IoT System design methodology	**L2**
CO-5	Implement IoT in real time scenario.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Introduction to IOT (RESE-235/ RESE-245)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	3	3	0	0	0	0	0	0	2
CO-2	3	2	2	3	3	0	0	0	0	0	0	3
CO-3	3	2	2	3	3	0	0	0	0	0	0	3
CO-4	3	2	2	3	3	0	0	0	0	0	0	2
CO-5	3	2	2	3	3	0	0	0	0	0	0	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Programme: UG(R) **Class: B-Tech** **CE/CSE/CSE(AIML)/EEE/ME/AE**			**Year: II** **Semester: III**
Credits: 4		**Category**	**ESE**
Theory	**Practical**	**Course Code**	**RESE-236/ RESE-246**
4	**NA**	**Course Name**	**Renewable Energy Systems**

Course Objectives:
1. To understand energy scenario, energy sources and their utilization.
2. To explore society's present needs and future energy demands.
3. To study the principles of renewable energy conversion systems.
4. To expose students to energy conservation methods

Nature of Paper: (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Principles of renewable energy; energy and sustainable development, fundamentals and social implications. worldwide renewable energy availability, renewable energy availability in India, brief descriptions on solar energy, wind energy, tidal energy, wave energy, ocean thermal energy, biomass energy, geothermal energy, oil shale. Introduction to Internet of energy (IOE).	**9L**
II	**Solar Energy**: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Solar radiation Measurements- Pyrheliometers, Pyrometer, Sunshine Recorder. Solar Thermal systems: Flat plate collector; Solar distillation; Solar pond electric power plant. Solar electric power generation- Principle of Solar cell, Photovoltaic system for electric power generation, advantages, Disadvantages and applications of solar photovoltaic system.	**9L**
III	**Wind Energy**: Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, Basic components of wind energy conversion system (WECS); Classification of WECS- Horizontal axis- single, double and multi blade system. Vertical axis- Savonius and Darrieus types. **Biomass Energy**: Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies-fixed dome; Urban waste to energy conversion; Biomass gasification (Downdraft)	**9L**

IV	**Tidal Power:** Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, advantages and limitations. Ocean Thermal Energy Conversion: Principle of working, OTEC power stations in the world, problems associated with OTEC.	**9L**
V	**Green Energy**: Introduction, Fuel cells: Classification of fuel cells – H2; Operating principles, Zero energy, Concepts. Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only), hydrogen energy storage, applications of hydrogen energy, problem associated with hydrogen energy.	**9L**

Text Books:

1. *Nonconventional Energy sources, G D Rai, Khanna Publication, Fourth Edition,*
2. *Energy Technology, S.Rao and Dr. B.B. Parulekar, Khanna Publication.*
3. *Solar energy, Subhas P Sukhatme, Tata Mc Graw Hill, 2ndEdition,1996. 16-2-2023.*

Reference Books:

1. *Principles of Energy conversion, A. W. Culp Jr.,, McGraw Hill, 1996.*
2. *Non-Convention Energy Resources, Shobh Nath Singh, Pearson, 2018.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **No**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3)Assignments	20
4)Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Basics of Energy

Course Learning Outcomes:

CO-1	Describe the environmental aspects of renewable energy resources in comparison with various conventional energy systems, their prospects and limitations.	**L2 & L3**
CO-2	Describe the use of solar energy and the various components used in the energy production with respect to applications like-heating, cooling, desalination, power generation.	**L1 & L2**
CO-3	Understand the conversion principles of wind and tidal energy	**L1& L2**
CO-4	Understand the concept of biomass energy resources and green energy.	**L2 & L3**
CO-5	Acquire the basic knowledge of ocean thermal energy conversion and hydrogen energy.	**L2**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping Renewable Energy Systems (RESE-236/ RESE-246)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	2	2	1	1	3	2	3	0	0	0	0	3
CO-2	2	2	2	1	3	2	3	0	0	0	0	3
CO-3	2	2	3	1	3	2	3	0	0	0	0	3
CO-4	2	2	2	1	3	2	3	0	0	0	0	3
CO-5	2	2	1	1	3	2	3	0	0	0	0	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech CE**			**Year: II** **Semester: III**
Credits: 4		**Category**	**Engineering Science Electives**
Theory	**Practical**	**Course Code**	**RESE-237/RESE-247**
4	**NA**	**Course Name**	**Basics of Thermal Engineering**

Course Objectives:

1. To understand the fundamental laws of thermodynamics and their application to engineering systems.
2. To analyze thermodynamic cycles used in power generation and refrigeration systems.
3. To apply heat transfer principles in conduction, convection, and radiation to solve engineering problems.
4. To evaluate the performance of thermal systems such as internal combustion engines and heat exchangers.
5. To understand the principles of power plant engineering and their environmental implications.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3	**T:** 1	**P:** 0	**C:** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Thermodynamics** ▪ Basic concepts: System, control volume, properties (temperature, pressure, specific volume), state, process, cycle ▪ Zeroth law of thermodynamics: Concept of temperature ▪ First law of thermodynamics: Energy balance, work, heat transfer ▪ Second law of thermodynamics: Entropy, reversibility, irreversibility ▪ Thermodynamic properties: Internal energy, enthalpy, entropy ▪ Ideal gas laws and equations of state (e.g., PV=nRT)	**9L**
II	**Thermodynamic Processes and Cycles** ▪ Types of processes: Isothermal, isochoric, isobaric, adiabatic, polytropic ▪ Work and heat transfer calculations in thermodynamic processes ▪ Power cycles: Carnot cycle, Otto cycle, Diesel cycle ▪ Vapor power cycles: Rankine cycle ▪ Refrigeration cycles: Vapor compression refrigeration cycle	**9L**
III	**Heat Transfer: Conduction and Convection** ▪ Modes of heat transfer: Conduction, convection, radiation ▪ Conduction: Fourier's law, steady-state one-dimensional conduction in simple and composite systems, critical radius of insulation for cylindrical systems ▪ Forced Convection: Hydrodynamic and thermal boundary layers, flow over flat plates, cylinders, and spheres	**9L**

	▪ Natural Convection: Buoyant force, empirical heat transfer correlations for planes and cylinders	
IV	**Heat Transfer: Radiation and Applications** ▪ Basic radiation concepts: Blackbody radiation, Stefan-Boltzmann law, Wien's displacement law, Kirchhoff's law ▪ Surface properties: Emissivity, absorptivity, reflectivity ▪ Radiation exchange between surfaces, shape factor calculations ▪ Applications: Heat transfer in extended surfaces (fins), solar energy, industrial furnaces	**9L**
V	**Applications in Thermal Systems** ▪ Internal combustion engines: Spark ignition (SI) and compression ignition (CI), performance parameters (power, efficiency, specific fuel consumption) ▪ Refrigeration systems: Coefficient of Performance (COP), refrigerants ▪ Heat exchangers: Types (parallel-flow, counter-flow), Logarithmic Mean Temperature Difference (LMTD) method, Effectiveness-NTU method ▪ Power plant engineering: Types (thermal, hydro, nuclear), components (boilers, turbines), environmental considerations	**9L**

Text Books:

1. *Thermodynamics: An Engineering Approach* by Yunus A. Cengel and Michael A. Boles, McGraw- Hill.
2. *Heat and Mass Transfer* by Yunus A. Cengel, McGraw-Hill.
3. *Internal Combustion Engines* by V. Ganesan, McGraw-Hill.

Reference Books:

1. Thermodynamics: An Engineering Approach by Yunus A. Cengel and Michael A. Boles, McGraw- Hill.
2. Heat and Mass Transfer by Yunus A. Cengel, McGraw-Hill.
3. Internal Combustion Engines by V. Ganesan, McGraw-Hill.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	**Max. Marks**
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3)Assignments	20
4)Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**
Prerequisites for the course:	
Course Learning Outcomes:	

CO-1	Explain the fundamental laws of thermodynamics and their application to engineering systems.	L2 &L3
CO-2	Analyze thermodynamic cycles for power generation and refrigeration.	L2 &L3
CO-3	Apply heat transfer principles in conduction and convection to	L2 &L3

	engineering problems.	
CO-4	Apply heat transfer principles in radiation and design thermal systems like fins and furnaces.	L2 &L3
CO-5	Evaluate the performance of thermal systems (engines, heat exchangers, power plants) and their environmental impact.	L2 &L3

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Basics of Thermal Engineering (RESE-237/RESE-247)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	-	1	-	-	-	-	-	-	-	1
CO-2	3	3	2	2	-	-	-	-	-	-	-	1
CO-3	3	3	2	2	2	-	-	-	-	-	-	1
CO-4	3	3	2	2	2	-	-	-	-	-	-	
CO-5	3	2	-	1	-	-	-	-	-	-	-	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech CE**			**Year: II** **Semester: III**
Credits: 4		**Category**	**Engineering Science Electives**
Theory	**Practical**	**Course Code**	**RESE-238/ RESE-248**
4	**NA**	**Course Name**	**Material Science**

Course Objectives:

1. To understand the fundamental concepts of crystal structures, imperfections, and their impact on material properties.
2. To develop skills in measuring and interpreting mechanical properties of materials through various testing methods.
3. To interpret phase diagrams and understand microstructural development in alloys.
4. To explore heat treatment processes and their effects on steel microstructures and properties.
5. To study the properties and applications of various alloys, including steel, cast irons, and non-ferrous alloys.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 3	**T:** 1	**P:** 0	**C:** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Crystallography and Imperfections:** Introduction, Importance of materials Concept of unit cell, space lattice, Bravais lattices, common crystal structures; Atomic packing factor and density; X-ray crystallography techniques; Imperfections, Defects & Dislocations in solids.	9L
II	**Mechanical properties and Testing:** Stress-strain diagram; Ductile & brittle materials; Stress vs. Strength; Toughness, Hardness, Fracture, Fatigue and Creep; Testing: Strength testing, Hardness testing, Impact testing, Fatigue testing, Creep testing, Non-destructive testing (NDT). **Micro-structural Examination:** Microscope principle and methods; Preparation of samples and Microstructure examination and grain size determination; Comparative study of microstructure of various metals & alloys such as Mild Steel, GI, Brass.	9L
III	**Phase Diagrams** Introduction, plotting of binary diagram, equilibrium cooling of an alloy, solid solutions, eutectic, eutectoid and peritectic systems, Iron-Iron carbide (Iron Carbon)equilibrium diagram- various phases present, various reactions involved, critical points, explanation of Iron Carbon diagram; phase rule.	9L

V	**Heat treatment:** Annealing, tempering, normalizing and spheroidizing, isothermal transformation diagrams for Fe-C alloys and microstructure development, Continuous cooling curves and interpretation of final microstructures and properties, austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.	**9L**
V	Alloying of steel, properties of stainless steel and tool steels, maraging steels- cast irons; grey, white, malleable and spheroidal cast irons-copper and copper alloys; brass, bronze andcupro-nickel; Aluminium and Al-Cu – Mg alloys- Nickel based super alloys and Titanium alloys.	**9L**

Text Books:

1. Material Science, R. K. Rajput, S.K. Kataria& Sons
2. Materials Science And Engineering, I.P. Singh, SubashChander, & Rajesh Kumar Prasad, 13th edition, John brothers.
3. Material Science Material Science In Engineering, DR. K.M. GUPTA, Umesh

Reference Books:

1. Material Science and Engineering, V. Raghavan, Prentice Hall
2. Materials Science and Engineering An Introduction, W.D. Callister, John Wiley
3. Mechanical Behaviour of Materials, Courtney, McGraw-Hill

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	**Max. Marks**
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	**Analyze crystal structures, imperfections, and mechanical properties using tensile, compression, and hardness tests.**	**L2**
CO-2	Evaluate static and fatigue failure mechanisms using failure theories and stress- life approaches	**L2**
CO-3	Interpret binary phase diagrams and microstructural development in alloys, including Fe-C systems.	**L2**
CO-4	Apply heat treatment processes to control steel microstructures and properties.	**L4**
CO-5	Assess the properties and applications of steel, cast irons, and non-ferrous alloys.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Material Science (RESE-238/ RESE-248**)**

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	0	0	1	0	0	0	0	0	0	1
CO-2	3	3	2	2	2	0	0	0	0	0	0	1
CO-3	3	3	2	2	2	1	1	0	0	1	0	1
CO-4	3	3	2	2	2	1	1	0	0	1	0	1
CO-5	3	3	3	2	3	1	1	0	0	1	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech CE**			**Year: II** **Semester: III**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**RTCE-232**
4	**NA**	**Course Name**	**Surveying & Geomatics**

Course Objectives:

1. The purpose of geodesy is to compile a map that shows the relative positions of objects on the Earth's surface.
2. Develop methods based on the knowledge of modern science and technology and use them in the field.
3. Well knowledge about level of grounds for many construction work.
4. Plane table surveying is a graphical surveying method used to create maps and plans, and to gather details such as topographical details) through field observations
5. All curves of roads and railways based on survey methods.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Surveying**- Principles, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, Bearing of survey lines, Local attraction, Declination, Dip, Latitude and Departure, Methods of orientation, Principle of resection.	**9L**
II	**Linear measurement:** chain and tape surveying, types of chain and tape, ranging, obstacles and tape correction. Compass surveying: Measurement of directions, Reference meridians, bearing and azimuths, local attraction. Theodolite survey: Vernier theodolite, Measurements of horizontal and vertical angles, Horizontal Control.	**9L**
III	**Levelling: Principles of levelling**- Dumpy level booking and reducing levels, Methods- simple, differential, reciprocal levelling, profile levelling and cross sectioning. Introduction of Digital and Auto Level, Errors in levelling **Contouring:** Characteristics, methods, uses	**9L**
IV	**Plane Table Surveying** Parts and accessories. Methods of surveying. Two-point and three-point problems.	**9L**

V	**Elements of simple circular curves:** theory and methods of setting out simple circular curves, transition curves- types and their characteristics, ideal transition curve, Introduction to vertical curves, Survey Layout for culverts, canals, bridges, road/railway alignment and buildings.	**9L**

Text Books:
1. BC Punamia et al: Surveying Vol. I, II, Laxmi Publication
2. AM Chandra: Plane Surveying, Higher Surveying, Naros14
3. SK Duggal, Surveying Vol. I, II, McGraw Hill Education

Reference Books:
1. Charles D. Ghilani, Elementary Surveying Pearson Education
2. R Subramanian : Surveying & Leveling , Oxford University Pres
3. Schofield, "Engineering Surveying" 6/e, CRC Press Taylor & Francis Group

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	Identify relevant type of construction materials for the given type of building.	**L1 & L2**
CO-2	Use the relevant type of special purpose construction materials in the given situation	**L2 &L3**
CO-3	Undertake the given type of building construction activity for the given component of building structure	**L1& L3**
CO-4	Design the relevant means of communication for the given building structure.	**L2 & L3**
CO-5	Use the relevant type of material for finishing purpose in the given situation.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Surveying & Geomatics (RTCE-232)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	2	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech CE**			**Year: II** **Semester: III**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**RTCE-231**
4	**NA**	**Course Name**	**Mechanics of Solids**

Course Objectives:
1. To understand fundamentals regarding Mechanics of Solids.
2. To develop ability of students to carry out analysis of complex state of stress.
3. To familiarize students about the failure modes of materials.
4. To understand the thick and thin cylinder working process.
5. To enhance skills of utilizing materials of appropriate strength for civil engineering

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**U Simple stresses & strains Basics of stress and strain:** 3 -D state of stress (Concept only) Normal/axial stresses: Tensile & compressive Stresses: Shear and complementary shear Strains: Linear, shear, lateral, thermal and volumetric. Hooke‟s law, Elastic Constants: Modulus of elasticity, Poisson‟s ratio, Modulus of rigidity and bulk modulus and relations between them with derivation. Application of normal stress & strains: Homogeneous and composite bars having uniform & stepped sections subjected to axial loads and thermal loads, analysis of homogeneous prismatic bars under multidirectional stresses. **Theories of failure**, thermal stresses, strain energy, impact loads and stresses	**9L**
II	**Types of loads**, Types of supports, Types of beams; Determination of support reactions, Relationship between loading, shear force & bending moment, Bending moment and shear force diagrams for beams subjected to only three types of loads :i) concentrated loads ii) uniformly distributed loads iii) couples and their combinations; Point of contra flexure, point & magnitude of maximum bending moment, maximum shear force	**9L**
III	**Torsion Loads:** Torsion of solid and hollow circular shafts, stepped and composite shafts, combined bending & torsion of solid & hollow shafts, torsion of thin walled tubes	**9L**
IV	**Columns and Struts:** Buckling and stability, slenderness ratio, combined bending and direct stress, middle third and middle quarter rules, columns	**9L**

	and struts with different end conditions, Euler‟s theory for pin ended columns, effect of end conditions on column buckling, Ranking Gordon formulae, examples of columns and struts	
V	**Thin cylinders & spheres:** Introduction, difference between thin walled and thick walled pressure vessels, hoop and axial stresses and volumetric strains in thin walled cylindrical shells and spheres under internal pressure. 1. Introduction to longitudinal stresses, circumferential or hoop stresses and radial stresses 2. Longitudinal and circumferential stresses in thin cylinder 3. Longitudinal and circumferential stresses in thin Spherical shells	**9L**

Text Books:

1. Strength of Materials by Timoshenko and Yσungs, East West Press.
2. Mechanics of Materials by Hibbeler, Pearson.
3. Mechanics of Materials", 2nd Ed by Timoshenko, S.P., and Gere, J.M., CBS Publishers

Reference Books:

1. Mechanics of Materials by Beer, Johnston, Dewolf and Mazurek, McGraw Hill India.
2. Strength of Materials by Pytel and Singer, Harper Collins

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	Understand the concepts of stress and strain at a point as well as the stress-strain relationships.	**L1 & L2**
CO-2	Be familiar with the institutions in the field of environment Learn about the different kinds of loading on the structure.	**L1 L2,L3**
CO-3	Apply mathematics science, for engineering applications and ability to identify, formulates, and solves engineering problems	**L1& L3**
CO-4	Analyse and design structural members subjected to tension, compression, torsion, bending and combined stresses using the fundamental concepts of stress, strain and elastic and solve the concept of thick and thin cylinder.	**L2 & L3**
CO-5	Made the necessary theoretical background for further structural analysis.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Mechanics of Solids (RTCE-231												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	2	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech CE**			**Year: II** **Semester: III**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**RTCE-233**
4	**NA**	**Course Name**	**Building Construction and Maintenance Engineering**

Course Objectives:

1) To how the wood, cement, admixtures is used for buildings and construction process.
2) To develop the building walls and foundations and how they are useful for buildings.
3) In these mainly we know about building arches, roofs, doors, windows and ventilators and how they are given for buildings.
4) To develop the form work and finishing work which is used for buildings and to solve the defects of building properties which are able to know with material
5) To understand the Principles of Building Planning and building types.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Study of building Materials:** Building materials and their performance, economics of the building materials. **Stones and Bricks**, Tiles: Building stones – classifications and quarrying – properties – structural requirements – dressing. Bricks – Composition of Brick earth – manufacture and structural requirements, **Fly ash, Ceramics. Timber, Aluminium, Glass, Paints and Plastics: Wood:** structure – types and properties – seasoning – defects; alternate materials for Timber – GI / fibre – reinforced glass bricks, steel& aluminium, Plastics.	**9L**
II	**Cement Concrete:** Constituent materials and their properties, Grades of concrete, Factors affecting strength, Properties of concrete at fresh and hardened stage, Testing of concrete, Methods of Curing of concrete. **Pozzolona:** Chemical composition and requirements for uses, Natural and Artificial fly ash, Surkhi (burnt clay pozzolona), rice husk and ash pozzolona, properties and specifications for use in construction. **Asphalt:** Bitumen and Tar: Terminology, specifications and uses, Bituminous materials.	**9L**

III	**Admixtures** – mineral & chemical admixtures – uses. **Plastics:** classification, advantages of plastics, Mechanical properties and use of plastic in construction. **Paints, varnishes and distempers:** Common constituents, types and desirable properties, Cement paints.	**9L**
IV	**Building Services: Plumbing Services:** Water Distribution, Sanitary – Lines & Fittings; Ventilations: Functional requirements systems of ventilations. Air conditioning - Essentials and Types; Acoustics – characteristic – absorption – Acoustic design; Fire protection – Fire Hazards – Classification of fire resistant materials and constructions. **Insulating Materials:** Thermal and sound insulating material, desirable properties and types.	**9L**
V	**Buildings:** Components of building, area considerations, Construction Principle and Methods for layout, damp proofing, anti-termite treatment in buildings, Vertical circulation means: stair cases and their types, design and construction. Different types of floors, and flooring materials (Ground floor and upper floors). Bricks and stone masonry construction, Cavity wall & hollow block construction.	**9L**

Text Books:

1. SK Duggal, "Building Materials" New Age International
2. BC Punmia, "Building Construction" Laxmi Publication.
3. PC Varghese, "Building Materials" PH

Reference Books:

1. Adams, "Building Construction" CRC Press Taylor & Francis Group.
2. Sandeep Mantri, "Practical building Construction and its Management" Satya Publisher, New Delhi
3. Deodhar, "Civil Engineering Materials" Khanna Publishers

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	Understand the concepts of stress and strain at a point as well as the stress-	**L1 & L2**

	strain relationships.	
CO-2	Be familiar with the institutions in the field of environment Learn about the different kinds of loading on the structure.	**L1 L2,L3**
CO-3	Apply mathematics science, for engineering applications and ability to identify, formulates, and solves engineering problems	**L1& L3**
CO-4	Analyse and design structural members subjected to tension, compression, torsion, bending and combined stresses using the fundamental concepts of stress, strain and elastic and solve the concept of thick and thin cylinder.	**L2 & L3**
CO-5	Made the necessary theoretical background for further structural analysis.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Building Construction and Maintenance Engineering(RTCE-233)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	2	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech CE**			**Year: II** **Semester: III**
Credits: 4		**Category**	**SEC**
Theory	**Practical**	**Course Code**	**RSCE-231**
4	**NA**	**Course Name**	**Green Construction Material & Technology**

Course Objectives:
1. To imbibe basics of green design and sustainable development concept.
2. To identify various area of implementing strategies for green design in projects to enhance built environment.
3. To learn institutional guidelines for development and certification of green designs.

Nature of Paper: SEC(Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T : 0**	**P : 0**	**C : 2**

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Green Building Concept:** Overview of green building movement; Concept of Green building and sustainable development; Issues and strategies of Green building and sustainable development; Objectives Principals and Benefits of Green building design; Introduction to High performance building; integrated design process of high performance building; Green project requirements and strategies; Overview of various green rating systems worldwide	**9L**
II	**Green Building Materials and Indoor Environment Quality**: Introduction; Low emitting materials; Building and material reuse; Construction waste management; Regional materials; Life cycle cost assessment of building materials and products; Factors affecting indoor environment quality; Ventilation and filtration; Building materials and finishes- Emittance level; Indoor Environment quality best practice.	**9L**
III	**Water: Reduce, Reuse and Recycle**: Introduction; Waste water strategy and water reuse/recycling; Water fixturesand water use reduction strategies.	**9L**
IV	**Energy efficient designs:** Passive cooling and day lighting- Active solar and hotovoltaic- Building energy analysis methods-Building energy simulation-Building ergyefficiency standards- Lighting system design-Lighting economics and aesthetics- Impacts of lighting efficiency-Energy audit and energy targeting-Technological options for energy management. Thermal comfort	**9L**

V	**IGBC Guidelines:** Introduction; IGBC green new building Rating system – Overview and process – project checklist; Sustainable architecture and design; Site selection and planning; Water conservation and energy efficiency; Building materials and resources; Indoor Environment quality; Innovation and development	**9L**

Text Books:

1. Sam Kubba, "Hand book of Green building Design and construction", Elsevier Architecture Press.
2. Abe Kruger and Carl Seville, "Green building: principals and practice in residential construction", Cengage Learning.

Reference Books:

1. GRIHA Manual Volume-1: Introduction to National Rating System by Ministry of New and Renewable Energy, Government of India and the energy and resource institute, New Delhi.
2. Kibert, C. "Sustainable Construction: Green Building Design and Delivery", John Wiley &Sons, 2005

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	10
2) Presentations /Seminar	NA
3) Assignments	5
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	35
Total:	**50**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	Demonstrate green concept skills and apply tools of Green building assessment.	**L1 & L2**
CO-2	Select appropriate green building material and technique.	**L1& L2**
CO-3	Design sustainable and energy efficient civil engineering project.	**L1& L3**
CO-4	Carry out Green Building rating using IGBC guidelines.	**L2 & L3**
CO-5	Institutional guidelines for development and certification of green designs.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Green Construction Material & Technology(RSCE-231)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	2	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech CE**			**Year: II** **Semester: III**
Credits: 2		**Category**	**Core**
Theory	**Practical**	**Course Code**	**RTCE-231P**
NA	**2**	**Course Name**	**Mechanics of Solids Lab**

Course Objectives:

1. Students will be able to understand basic concepts of stress, strain and their relations based on linear elasticity. Material behaviors due to different types of loading will be discussed.
2. Students will be able to understand and know how to calculate stresses and deformation of a bar due to an axial loading under uniform and non-uniform conditions.
3. Students will understand how to develop shear-moment diagrams of a beam and find the maximum moment/shear and their locations
4. Students will understand how to calculate normal and shear stresses on any cross-section of a beam. Different cross-sections (including I-beam) will be discussed
5. Students will be able to understand basic concepts of stress, strain and their relations based on linear elasticity. Material behaviors due to different types of loading will be discussed.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	**T :** 0	**P :** 2	**C :** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	**Practical Title**
Practical-1.	Tension test on Mild Steel
Practical-2.	Bending tests on simply supported beam and Cantilever beam.
Practical-3.	Determination of torsion and deflection
Practical-4.	Measurement of forces on supports in statically determinate beam
Practical-5.	Determination of shear forces in beams
Practical-6.	Determination of bending moments in beams
Practical-7.	Measurement of deflections in statically determinate beam.
Practical-8.	To determine Flexural Rigidity (EI) of a given beam
Practical-9.	To find deflection of curved members.
Practical-10.	To find Critical load in Struts with different end conditions.

Reference/Text Books:

1. Strength of material, Ananad jaya kumar Arumugham
2. Strength of material, R.S. Khurmi & N.Khurmi
3. Strength of material, S S Rattan 3rd edition

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		05
3)External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	To understand the behaviour of the solid bodies subjected to various types of loading	**L1**
CO-2	Application of knowledge on the different materials and structural elements to the analysis structures.	**L3**
CO-3	In the identification and formulation of the problems related to the solid mechanics.	**L2 & L3**
CO-4	Analyse the laboratory data behaviour of structures and the materials they are made of.	**L2 & L3**
CO-5	To Check the capacity of structure members to undertake lifelong learning.	**L3 & L1**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Mechanics of Solids Lab(RTCE-231P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	0	2	1	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	3	3	1	0	0	0	0	0	0	2	1
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech CE**			**Year: II** **Semester: III**
Credits: 2		**Category**	**Core**
Theory	**Practical**	**Course Code**	**RTCE-232P**
NA	**2**	**Course Name**	**Surveying & Geomatics Lab**

Course Objectives:

1. The purpose of the Survey Lab is to enable students to develop maps of appropriate scale using a variety of surveying instruments such as total stations, theodolites, auto-levels, global positioning systems (GPS), and geographic information systems. It is to acquire enough knowledge and ability to draw.), electromagnetic distance measurement (EDM)
2. The main object of surveying lab to make a superstructure or infrastructure alignment on proper way according to map.
3. Well knowledge about setting out of curve.
4. With the help of this we can easily find out the levels of construction projects, which is very important part for civil engineering.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	**T :** 0	**P :** 2	**C :** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Measurement of distance by Ranging and Chaining
Practical-2.	To measure distance by chain survey
Practical-3.	Locating various objects by Chain & Cross staff surveying. Determination of area of polygon by Chain and Cross staff survey
Practical-4.	Measurement of bearings of sides of traverse with Prismatic Compass and computation of correct included angle.
Practical-5.	Determination of elevation of various points with dumpy level by Collimation Plane Method and Rise & Fall Method.
Practical-6.	To study parts of a Vernier theodolite and measurement of horizontal and vertical angle.
Practical-7.	To measure horizontal angle by reiteration method.
Practical-8.	To determine the height of a vertical structure (e.g. chimney/ water tank etc.) using trigonometrically Leveling by taking observations in single vertical plane
Practical-9.	To set out a simple circular curve by Rankine‟s method.
Practical-10.	To plot contour map of given area

Reference/Text Books:

1. Surveying and Levelling, Vol I by S.S. Bhavikatti
2. Surveying Volume – 1, 5th Edition by S. K. Duggal
3. Surveying & Levelling Vol - Ii by T P Kanetkar |

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce (External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	To understand work with many Civil engineering applications such as structural plot and road profiling using traditional surveying tools such as chain/tape measures, compasses, plane tables and levels etc.	**L1**
CO-2	To create properly plan a survey with the ability to understand the environment.	**L3**
CO-3	To evaluate accurate measurements, field submissions, plots, and error corrections can be tracked.	**L2 & L3**
CO-4	To apply fieldwork techniques and work as a research team.	**L2 & L3**
CO-5	To construct a contour map for different regions.	**L3 & L1**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Surveying & Geomatics Lab(RTCE-232P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	0	2	1	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	3	3	1	0	0	0	0	0	0	2	1
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech CE**			**Year: II** **Semester: III**
Credits: 2		**Category**	**Core**
Theory	**Practical**	**Course Code**	**RTCE-233P**
NA	**2**	**Course Name**	**Building Construction and Maintenance Engineering Lab**

Course Objectives:

1. Describe the physical characteristics of aggregates, sources and manufacturing processes for gravels, engineering properties of aggregates, and how aggregates are classified.
2. Name the constituents of Portland cement concrete and proportion concrete mix designs.
3. Describe the fieldwork and inspections necessary for successful results in concrete construction
4. Conduct and document laboratory investigations.
5. Work in small teams with individuals of diverse cultural backgrounds.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	**T :** 0	**P :** 2	**C :** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Units	Practical Title
Practical-1.	To determine normal consistency of cement by Vicat‟s apparatus.
Practical-2.	To determine initial & final setting time of cement by Vicat‟s apparatus.
Practical-3.	To determine compressive strength of cement.
Practical-4.	To determine soundness of cement by Le-chatalier‟s apparatus.
Practical-5.	To determine fineness of cement by air permeability and sieve analysis.
Practical-6.	To determine amount of water absorption of aggregate.
Practical-7.	To perform sieve analysis test on aggregate.
Practical-8.	To determine specific gravity & bulk density of coarse aggregates
Practical-9.	To determine grading of aggregates.
Practical-10.	To perform sieve analysis test on sand.

Reference/Text Books:

1. Building Construction and Material, Testing and Quality Control, M.L. Gambhir & Neha Jamwal
2. Testing of Construction Material, Ravi Kumar Sharma
3. Soil Testing Manual: Procedures, Classification Data, and Sampling Practices y Robert Day | by Whitman

Reference Books:

1. Testing of Civil Engineering Material, Ram Chandra Mardi

2. Buildings for Advanced Technology (Science Policy Reports) by Ahmad Soueid, E. Clayton Teague, et al. |
3. Building a K-12 STEM Lab: A Step-by-Step Guide for School Leaders and Tech Coaches by Deborah Kantor Nagler and Martha Osei-Yaw.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Learn about the aggregate & their grading characteristics.	**L1**
CO-2	Identify the quality of cement & their properties.	**L3**
CO-3	To identify the water absorption capacity of aggregate.	**L2 & L3**
CO-4	To implement the characteristics of bricks in construction.	**L2 & L3**
CO-5	To evaluate the quality of brick and differentiate their classes.	**L3 & L1**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Building Construction and Maintenance Engineering Lab (RTCE-233P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	0	2	1	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	3	3	1	0	0	0	0	0	0	2	1
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: UG(R) **Class: B.Tech CE**			**Year: II** **Semester: III**
Credits: 2		**Category**	**AECC**
Theory	**Practical**	**Course Code**	**RTAS-232P**
0	**2**	**Course Name**	**Integrated Communication Lab**

Course Objectives: The objectives of studying this course are

1. To enhance students' English communication skills through structured practice in listening, speaking, reading, and writing activities relevant to academic and professional contexts.
2. To develop interpersonal and presentation skills required for group discussions, interviews, seminars, and workplace communication.
3. To build confidence in public speaking and professional interaction by encouraging active participation in role plays, debates, and extempore sessions.
4. To improve pronunciation, fluency, and vocabulary through language lab sessions and interactive modules.
5. To prepare students for industry and higher education opportunities by aligning communication training with real-world scenarios and corporate expectations

Nature of Paper: AECC (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0	**T:** 0	**P:** 2	**C:** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

No	Contents	No. of Lectures Allotted
1	Introduction to Integrated Communication Lab and activities for self-introduction and ice-breaking.	2L
2	Listening comprehension practice through audio clips and note-taking exercises.	2L
3	Role play and conversation practice for formal and informal situations.	2L
4	Group discussion and JAM (Just a Minute) session for fluency enhancement	2L
5	Reading comprehension and vocabulary-building exercises from short passages.	2L
6	Email and resume writing for academic and professional purposes.	2L
7	Report writing and paragraph writing on given topics.	2L
8	Mock interviews and feedback on spoken communication.	2L
9	Oral presentation on technical or general topics using PPT.	2L
10	Pronunciation, stress, and intonation practice through language lab software.	2L

Text Books:

1. Rizvi, M. Ashraf. (2005). Effective Technical Communication. New Delhi: Tata McGraw-Hill

Education.
2. Kumar, Sanjay, & Lata, Pushp. (2018). Communication Skills. New Delhi: Oxford University Press.

Reference Books:
1. Meenakshi Raman & Sangeeta Sharma. (2015). Technical Communication: Principles and Practice (2nd ed.). New Delhi: Oxford University Press.
2. Carnegie, Dale. (1998). The Quick and Easy Way to Effective Speaking. New York: Pocket Books.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3)External Practical Assessment	External Assessment	20
4)Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Prerequisites for the course: Electronics Engineering

Course Learning Outcomes:

CO1	Develop effective listening skills to comprehend and analyse spoken English in academic and professional settings.	**L2**
CO2	Demonstrate improved spoken English fluency, pronunciation, and confidence in group discussions, role plays, and interviews.	**L3**
CO3	Enhance reading comprehension skills to interpret and critically analyse a variety of texts and media.	**L2**
CO4	Acquire the ability to write structured and professional documents like emails, resumes, and short reports.	**L3**
CO5	Deliver formal presentations and interviews with clarity, organization, and effective verbal/non-verbal communication.	**L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Integrated Communication Lab (RTAS-232P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	1	1	0	0	1	0	0	1	2	3	1	1
CO-2	0	1	1	0	1	1	0	1	3	3	2	2
CO-3	1	1	0	0	1	0	0	1	2	2	1	1
CO-4	1	0	1	0	1	0	0	1	2	3	2	2
CO-5	0	0	1	0	2	0	0	1	3	3	2	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech CE**			**Year: II** **Semester: IV**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**RTCE-241**
4	**NA**	**Course Name**	**Fluid Mechanics**

Course Objectives:

1. To introduce and explain fundamentals of Fluid Mechanics, which is used in the applications of Aerodynamics, Hydraulics, Marine Engineering, Gas dynamics etc.
2. To give fundamental knowledge of fluid, its properties and behaviour under various conditions of internal and external flows. 3
3. To develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow
4. To imbibe basic laws and equations used for analysis of static and dynamic fluids.
5. To inculcate the importance of fluid flow measurement and its applications in Industries

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**FLUID PROPERTIES AND FLUID STATICS** **Fluid** – definition, distinction between solid and fluid – Units and dimensions – Properties of fluids – density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, capillarity and surface tension – Fluid statics: concept of fluid static pressure, absolute and gauge pressures – pressure measurements by manometers-forces on planes – centre of pressure – buoyancy and floatation.	**9L**
II	**FLUID KINEMATICS AND DYNAMICS** Fluid Kinematics – Classification and types of flow – velocity field and acceleration – continuity equation (one and three dimensional differential forms)- stream line-streak line-path line- stream function – velocity potential function – flow net. Fluid dynamics – equations of motion - Euler‟s equation along a streamline – Bernoulli‟s equation – applications – venturi meter, orifice meter and Pitot tube- linear momentum equation and its application to pipe bend.	**9L**
III	**FLOW THROUGH PIPES** Reynold‟s experiment – laminar flow through circular pipe (Hagen	**9L**

	poiseulle‟s) –hydraulic and energy gradient – flow through pipes – Darcy – Weisbach‟s equation – pipe roughness -friction factor Moody‟s diagram- major and minor losses of flow in pipes – pipes in series and in parallel.	
IV	**Laminar & Turbulent flow:** Equation of motion for laminar flow through pipes, Stokes‟ law, transition from laminar to turbulent flow, turbulent flow, types of turbulent flow, isotropic, homogenous turbulence, scale and intensity of turbulence, measurement of turbulence, eddy viscosity, mixing length concept and velocity distribution in turbulent flow over smooth and rough surfaces. **Boundary layer:** Boundary layer – definition- boundary layer on a flat plate – laminar and turbulent boundary layer displacement, energy and momentum thickness – Momentum integral equation-Boundary layer separation and control – drag on flat plate.	**9L**
V	Drag and lift, drag on a sphere, a two dimensional cylinder, and an aerofoil, Magnus effect. Similarity Laws: geometric, kinematics and dynamic similarity, undistorted and distorted model studies, Dimensional analysis, Buckingham‟s Pi theorem, important dimensionless numbers and their significance.	**9L**

Text Books:

1. Hibbler, “Fluid Mechanics in SI Units” 1/e Pearson Education, Noida Building Construction, by B. C. Punmia, , Laxmi Publication.
2. Katz, “Introductory Fluid Mechanics” Cambridge University Press
3. Gupta, “Fluid Mechanics & Hydraulic Machines” Pearson Education, Noida

Reference Books:

1. Esposito, “Fluid Power & Applications” 7/e Pearson Education, Noida
2. Fox & Donald, “Introduction to Fluid Mechanics” John Wiley & Sons Pvt. Ltd,
3. Cengel & Cimbala, ”Fluid Mechanics” TMH, New Delhi

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	To understand the basic terms used in the fluid mechanics and understand the postulate of fluid statics and kinematics.	**L1 & L2**
CO-2	To understand the principles of the hydraulics and fluid mechanics	**L2 &L3**

CO-3	To get the functional recognition of the fluid properties.	**L1& L3**
CO-4	Undergraduate be able to apply the continuity and momentum equation in the field of field mechanics.	**L2 & L3**
CO-5	Determine the losses through the pipes and on the boundary layers.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Fluid Mechanics (RTCE-241)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	2	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech CE**			**Year: II** **Semester: IV**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**RTCE-242**
4	**NA**	**Course Name**	**Transportation Engineering**

Course Objectives:

1. Understand the interactions between transportation planning and land use planning, economics, social planning and master plans
2. To learn about highway location and alignment position, Have the capability to identify and solve transportation problems within the context of data availability and limitations of analysis tools.
3. Gain the facility of utilizing the state of the art techniques and models in the field.
4. To construct the highway pavement and its evaluation.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Role of Transportation, Modes of Transportation History of road development, Road types and pattern, Nagpur road plan, Bombay road plan & 3rd 20 Year Road Plan, NHAI Act (1988), Road Development Plan Vision: 2021 documents, Expressway Master Plan, Features of PMGSY.	**9L**
II	**Highway Alignment & Location Survey:** Horizontal Profile, Vertical Profile, Factors Controlling the alignment, Survey for route location, Preparation of Detailed Project Report (DPR) Geometric Design: Cross sectional elements, camber, shoulder, sight distance, horizontal curves, super elevation, extra widening, transition curves and gradient, vertical curves, summit and valley curves	**9L**
III	**Traffic Engineering:** Traffic Characteristics, traffic volume and speed study, traffic capacity, density, traffic control devices, signs, signals, Island, Intersection at grade and grade separated intersections, design of rotary intersection	**9L**
IV	**Highway Materials: Road Construction materials :** Properties of Subgrade, Aggregates & Binding materials, Various tests and specifications, Design of Highway Pavement : Types of Pavements, Design factors, Design of Flexible Pavement by CBR method (IRC : 37-2012), Design of rigid pavement, Westergaard theory, load and	**9L**

	temperature stresses, joints, IRC method of rigid pavement design (IRC:58-2011)	
V	**Highway Construction and ITS:** Construction of Subgrade, Water Bound Macadam (WBM), Wet mix macadam (WMM), Granular Sub Base (GSB),Tack Coat, Prime Coat, Seal Coat, Surface Dressing, Bituminous Macadam (BM), Semi dense bituminous concrete (SDBC) and Bituminous concrete, Dry lean concrete (DLC), Cement Concrete (CC) road construction, Roller Compacted Concrete Roads. Introduction to ITS, including where ITS fits; roles and responsibilities Advanced Traveller Information Systems (ATIS), including functionality; business models; field trip to Smart Route Systems	**9L**

Text Books:

1. Khanna, S. K. and Justo, C.E.G. "Highway Engineering", Nem Chand and Bros, Roorkee, 8th edition, 2011
2. Khanna, S. K and Arora, M.G & Jain, S. S, "Airport Planning and Design", Nem Chand and Bros, Roorkee, 2001
3. Transportation Engineering (Dip. IV Sem. CE) by S. S. Gurnule |

Reference Books:

1. Kadiyali, L. R., "Principles and Practice of Highway Engineering", Khanna Publishers Ltd. New Delhi, 2000
2. Sehgal, S.B and Bhanot, B. L, "Highway and Airport Engineering", S. Chand and Company Ltd. New Delhi, 1978
3. Venkatappa Rao, G., "Principles of Transportation and Highway Engineering", Tata McGraw Hill Publishing Co. Ltd. New Delhi, 2000.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	To understand the role of transportation and how to utilize it.	**L1 & L2**
CO-2	To identify the characteristics of traffic and how to design of signal & road intersection.	**L2 &L3**
CO-3	Compute the horizontal & vertical alignment and their uses in road transport.	**L1& L3**
CO-4	To differentiate the limits of speed of any vehicle on different road as per IRC.	**L2 & L3**
CO-5	To evaluate responsibilities of travels & smart route system for travels.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Transportation Engineering(RTCE-242)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	2	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech CE**			**Year: II** **Semester: IV**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**RDCE-241**
4	**NA**	**Course Name**	**Water resource engineering**

Course Objectives:

1. In we work in the field of engineering irrigation. we should know the amount of water entering the soil from where the plants can get water
2. If you are concerned about water resources, you need to know how much water will flow into your river so that you can control floods or avoid water shortages to irrigate other areas
3. 3.Knowledge of hydrology is a prerequisite for the design of irrigation techniques and hydraulic structures. Therefore, one of the goals of this course is to impart knowledge of hydrology, which deals with the occurrence, distribution, movement, and properties of water on Earth.
4. Know about different irrigation techniques, plant requirements.
5. .To learn more about canal irrigation distribution systems, design unlined and lined irrigation canals, design canal related sediment problems.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Necessity of irrigation- scope of irrigation engineering- benefits and ill effects of irrigation, irrigation development in India- types of irrigation systems, Soil-water plant relationship: Classification of soil water- soil moisture contents- depth of soil water available to plants permanent and ultimate wilting point	**9L**
II	**Water requirements of crops:** Depth of water applied during irrigation- Duty of water and delta improvement of duty command area and intensity of irrigation consumptive use of water and evapotranspiration irrigation efficiencies assessment of irrigation water	**9L**
III	**Methods of Irrigation:** Classification- choice of method of irrigation- surface and subsurface irrigation methods, Sprinkler and Drip Irrigation	**9L**
IV	**Design of Irrigation Channel:** Alignment- canal capacity- losses- FSL of canal design of canal in alluvial soil and non-alluvial soils- Kennedy‟s silt theory Lacey‟s regime theory- balancing depth- use of Garrets diagrams and Lacey‟s Regime diagrams- lining of irrigation channels- design of lined canal drainage behind lining. Water logging: Causes,	**9L**

	Measures: surface and sub-surface drains, land reclamation	
V	**Diversion head works:** Types- selection of the suitable site for the diversion headwork components of diversion headwork- Causes of failure of structure on pervious foundation- Khosla"s theory- Design of concrete sloping glacis weir. Cross drainage works: Types- selection of suitable type of CD works- aqueduct and Syphon aqueduct determination of maximum flood discharge and waterway for drain, fluming of canal- uplift pressure on underside of barrel roof and at the floor of the culvert- design of bank connections	**9L**

Text Books:

1. Modi, P.N., Irrigation Water Resources and Water Power Engineering, Standard Book House, New Delhi.
2. Garg, S.K., Irrigation Engineering and Hydraulic Structures, Khanna Publishers, New Delhi.
3. Sharma, R.K., Text book of Irrigation Engineering and Hydraulic Structures, Oxford and IBK Publishing House, New Delhi

Reference Books:

1. Sharma, S.K., Principlesand Practice of Irrigation Engineering, S. Chand & Company Pvt. Ltd, New Delhi
2. Punmia, B.C., and B.B. Pande, "Irrigation and Water Power Engineering", Laxmi Publication Pvt. Ltd., New Delhi
3. A.M. Micheal, "Irrigation, Theory and Practice", Vikas Publishing House Pvt. Ltd. New Delhi

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	To understand about various flows measurement techniques	**L1 & L2**
CO-2	To knowledge about the basic requirements of irrigation and different irrigation techniques, the requirements of crops etc.	**L2 &L3**
CO-3	To explain about canal irrigation distribution systems and the basics of designing unlined and lined irrigation canals.	**L1& L3**
CO-4	To apply application of mathematics, science and technology in the field of water resource engineering	**L2 & L3**
CO-5	To develop the spirit of working in team for common objectives	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Water resource engineering(RDSE-241)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	2	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech CE**			**Year: II** **Semester: IV**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**RDCE-242**
4	**NA**	**Course Name**	**Concrete Technology**

Course Objectives:

1. The route pertains to the basics associated with concrete and concrete fabric, besides dealing with masonry, reinforcement, and many others
2. The direction begins with an outline of what concrete is, what are the techniques concerned in formation of concrete, numerous substances that are utilized in concrete formation, homes of every aspect of concrete, widespread tests to be applied to concrete and urban substances.
3. The route then actions on to design-mix, special concretes, Nondestructive trying out, etc.
4. For safety purpose concrete technology is very important.
5. To study the role of high strength concrete.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Cement: Productions, composition properties, types and cement chemistry. Introduction to supplementary cementitious materials. Aggregates: mineralogy, properties, test and standards. Quality of water for use in concrete.	**9L**
II	Introduction & study of accelerators, retarders, water reducers, air entertainers, water proofers, super plasticizers. Study of supplementary cementing materials like fly ash, silica fume, ground granulated blast furnace slag, metakaoline and pozzolana; their production, properties and effect on concrete properties.	**9L**
III	Principle of mix proportioning, properties related to mix design, Mix design method (IS method and ACI method). Mix design of concrete: packing density, Rheology, mix design examples	**9L**
IV	Concert production, batching, mixing and transportation of concrete. Workability: test for workability of concrete (slump test, compacting factor test and Vee Bee test). Segregation and bleeding in concrete, curing of concrete and its methods. Determination of compressive and flexural strength as per BIS. Mechanical properties of concrete: elastic modules, Poisson's ratio, creep, shrinkage and durability of concrete.	**9L**

V	Study and uses of high strength concrete, self-compacting concrete, fiber reinforced concrete, Ferro cement, ready Mix Concrete, recycled aggregate concrete and status in India	**9L**

Text Books:

1. Neville, A.M. and Brooks, J.J.," CONCRETE TECHNOLOGY", ELBS.
2. Shetty, M.S, "Concrete Technology, Theory and Practice", S. Chand and Company Ltd, New Delhi, 2008.
3. Gambhir, M.L, "Concrete Technology", Tata McGraw Hill Publishing Company Ltd, New Delhi, 2004.

Reference Books:

1. Santha kumar, A.R; "Concrete Technology" , Oxford University Press, New Delhi, 2007.
2. Gupta B.L., Amit Gupta, "Concrete Technology", Jain Book Agency, 2010.
3. Newman, K., "CONCRETE SYSTEMS in COMPOSITE MATERIALS". EDT BY L Holliday. Elsevier Publishing Company. 1966.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	To understand about various flows measurement techniques	**L1 & L2**
CO-2	To knowledge about the basic requirements of irrigation and different irrigation techniques, the requirements of crops etc.	**L2 &L3**
CO-3	To explain about canal irrigation distribution systems and the basics of designing unlined and lined irrigation canals.	**L1& L3**
CO-4	To apply application of mathematics, science and technology in the field of water resource engineering	**L2 & L3**
CO-5	To develop the spirit of working in team for common objectives	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Concrete Technology (RDCE-242)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	0	0	0	2	2

CO-2	1	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	2	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech CE**			**Year: II** **Semester: IV**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**RDCE-243**
4	**NA**	**Course Name**	**Hydraulics and hydraulic machine**

Course Objectives:
1. Identify importance of various fluid flows.
2. derive and apply general governing equations for various fluid flows
3. Understand the concept of fluid flow.
4. To understand the phenomenon of hydraulic jump.
5. Evaluate the performance characteristics of hydraulic turbines and pumps and OCF

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Difference between open channel flow and pipe flow, geometrical parameters of a channel. Continuity equation for steady and unsteady flow. Critical depth, concepts of specific energy and specific force, application of specific energy principle for interpretation of open channel phenomena, flow through vertical and horizontal contractions	**9L**
II	Chezy‟s and Manning‟s equations for uniform flow in open channel, Velocity distribution, most efficient channel section, compound channels.	**9L**
III	Equation of gradually varied flow and its limitations, flow classification and surface profiles, integration of varied flow equation by analytical, graphical and numerical methods, Flow in channels of non-linear alignment specifically for the case of a bend.	**9L**
IV	Classical hydraulic jump, Evaluation of the jump elements in rectangular and non- rectangular channels on horizontal and sloping beds. Rotodynamic pumps, classification on different basis, basic equations, Velocity triangles, manometric head, efficiencies, cavitation in pumps, characteristics curves.	**9L**
V	Open channel surge, celerity of the gravity wave, deep and shallow water waves, Rectangular free overfall. Rotodynamic Machines, Pelton Turbine, equations for jet and rotor size, efficiency, spear	**9L**

	valve, reaction turbines, Francis and Kaplan type, Head on reaction turbine, unit quantities, similarity laws and specific speed, cavitation, characteristic curves.	

Text Books:

1. Chow,V.T."Open Channel hydraulics" McGraw Hill Publication
2. Subramanya, K., Flow through Open Channels, TMH, New Delhi
3. Ranga Raju, K.G., Flow through open channels, T.M.H. New Delhi

Reference Books:

1. Rajesh Srivastava, Flow through Open Channels , Oxford University Press
2. Streeter, V.L.& White E.B., "Fluid Mechanics" McGraw Hill Publication
3. RK Bansal "Fluid Mechanics and Hydraulic Machines" Laxmi Publication

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	To understand about various flows measurement techniques	**L1 & L2**
CO-2	To knowledge about the basic requirements of irrigation and different irrigation techniques, the requirements of crops etc.	**L2 &L3**
CO-3	To explain about canal irrigation distribution systems and the basics of designing unlined and lined irrigation canals.	**L1& L3**
CO-4	To apply application of mathematics, science and technology in the field of water resource engineering	**L2 & L3**
CO-5	To develop the spirit of working in team for common objectives	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Hydraulics and hydraulic machine **(RDCE-**243**)**												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	2	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech CE**			**Year: II** **Semester: IV**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**RDCE-244**
4	**NA**	**Course Name**	**Introduction to Sustainable Development**

Course Objectives:

1. To familiarize the students to the area of sustainability and concepts of sustainability engineering
2. To enable students with an understanding of principles and frame work of sustainable engineering
3. To provide students with an understanding of Life Cycle Assessment tool in sustainable engineering
4. To provide students with understanding of integration of sustainability with design.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Sustainable Development and Role of Engineers: Introduction, Why and What is Sustainable Development, THE SDFs, Paris Agreement and Role of Engineering, Sustainable Development and the Engineering Profession, Key attributes of the Graduate Engineering	**9L**
II	Sustainable Engineering Concepts: Key concepts – Factor 4 and Factor 10: Goals of sustainability, System Thinking, Life Cycle Thinking and Circular Economy	**9L**
III	Sustainable Engineering and Concepts, Principles and Frame Work: Green Economy and Low Carbon Economy, Eco Efficiency, Triple bottom Line, Guiding principles of sustainable engineering, Frameworks for sustainable Engineering. Tools for sustainability Assessment: Environmental Management System, Environmental Auditing, Cleaner Production Assessment, Environmental Impact Assessment, Strategic Environmental	**9L**
IV	Fundamentals of Life Cycle Assessment Why and What is LCA, LCA Goal and Scope, Life cycle inventory, Life Cycle Impact Assessment, Interpretation and presentation of Results, Iterative Nature of LCA, Methodological Choices, LCI Databases and LCA Softwares, Strength and Limitations of LCA.	**9L**
V	Environmental Life Cycle Costing, Social Life Cycle Assessment, and Life Cycle Sustainability Assessment: Introduction, Environmental Life	**9L**

	Cycle Costing, Social Life Cycle Assessment, Life Cycle Sustainability, LCA Applications in Engineering: Environmental Product Declarations and Product Category Rules, Carbon and Water Foot Printing, Energy systems, Buildings and the Built Environment, Chemical and Chemical Production Food and Agriculture Introduction to Environmental Economics: Introduction – What Is Environmental Economics?, Valuing the Environment, Market-based Incentives (or Economic Instruments) for Sustainability, Command-and-Control versus Economic Instruments, A Simple Model of Pollution Control	

Text Books:

1. Introduction to Sustainability for Engineers, Tool see ram Ramje a won, CRC Press, 1stEdn., 2020
2. Sustainability Engineering: Concepts, Design and Case studies, Prentice Hall, 1stEdn, 2015
3. System Analysis for sustainable Engineering: Theory and applications, Ni bin Chang, McGraw Hill Publications, 1st Edn., 2010

Reference Books:

1. Engineering for Sustainable development: Delivery a sustainable development goals, UNESCO, International Centre for Engineering Education, France, 1stEdn., 2021
2. Introduction to Sustainable Engineering, Rag. R.L. and Ramesh Lakshmi Dinachandran, PHI Learning Pvt. Ltd., 2ndEdn, 2016

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations/Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	Elucidate the basics of sustainable development, sustainable engineering and its role in engineering	**L1 & L2**
CO-2	Use the relevant type of special purpose construction materials in the given situation	**L2 &L3**
CO-3	Application of Sustainable Engineering Concepts and Principles in Engineering	**L1& L3**
CO-4	Apply the Principle, and methodology of Life Cycle Assessment Tool to engineering systems	**L2 & L3**
CO-5	Understand integration methods of sustainability to Engineering Design	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Introduction to Sustainable Development(RDCE-244)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	2	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech CE**			**Year: II** **Semester: IV**
Credits: 2		**Category**	**LAB**
Theory	**Practical**	**Course Code**	**RTCE-242P**
NA	**2**	**Course Name**	**Transportation Engineering LAB**

Course Objectives:
1. To understand the shape and size of the aggregate
2. To check the abrasive strength of the aggregate.
3. To find out the specific gravity of the coarse aggregate
4. To find out the hardness of aggregate.
5. To understand the different properties of the bitumen.

Nature of Paper: Core (Lab)

Minimum Passing Marks/50% Marks / 2 Credits) 50% of Internal Assessment & 50% of External Assessment

L : 0	**T :** 0	**P :** 2	**C :** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical No.1	Flakiness and elongation test
Practical No.2	C B R Value test
Practical No.3	Impact value Test
Practical No.4	Abrasion Test
Practical No.5	Specific gravity test
Practical No.6	Penetration test of bitumen
Practical No.7	Aggregate Hardness test
Practical No.8	Ductility of bitumen
Practical No.9	Aggregate Water absorption Test
Practical No.10	Fire and flash point of bitumen

Reference/Text Books:
1. Transportation Engineering Lab Manual by Prof Harshal Pandule, Prof Chetan More, et al.
2. Laboratory manual in highway ingineering by Ajay k Duggal Vijay P puri
3. Transportation engineering lab manual by Christy C. J.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal	10

2) Presentation/Seminar/Viva-Voce(Internal)	Assessment	05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	To understand the properties of aggregates.	**L4**
CO-2	To identify the quality of aggregates.	**L3**
CO-3	Apply the concept of utilization of the grade of bitumen and their properties.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Transportation Engineering LABb(RTCE-242P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	0	2	1	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	3	3	1	0	0	0	0	0	0	2	1
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech CE**			**Year: II** **Semester: IV**
Credits: 2		**Category**	**CLAB**
Theory	**Practical**	**Course Code**	**RTCE-243P**
NA	**2**	**Course Name**	**CAD Lab**

Course Objectives:
To learn software like AutoCAD, Invertor/ Pro E/ Uni-graphics and to produce basic concepts to make 2D drafting

1. To apply basic concept to drawing, edit, dimension, hatching etc. to develop 2D & 3D Modelling
2. To make 3D modelling, Assembling, modification & manipulation along with detailing.
3. To prepare surface modelling and sheet metal operations through various exercises
4. To understand and resolve the one dimensional problem using FEM.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	**T :** 0	**P :** 2	**C :** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Introduction of AUTOCAD and write down the different command of AUTOCAD.
Practical-2.	Draw different types of shape using Auto CAD (Rectangle, Ellipse, Circle, Square, Hexagon, Pentagon, Octagon, etc)
Practical-3.	Draw single line plan of two room set house using Auto CAD.
Practical-4.	Draw single line plan of residential building using Auto CAD (2BHK)
Practical-5.	Draw single line plan of commercial building using Auto CAD (Hospital)
Practical-6.	Draw single line plan of commercial building using Auto CAD (School)
Practical-7.	Draw double line plan of residential building using Auto CAD (2BHK)
Practical-8.	Draw double line plan of commercial building using Auto CAD (Hospital)
Practical-9.	Draw single line plan of commercial building using Auto CAD (School)
Practical-10.	Drawings using AUTOCAD software for the following:- a) Simply supported, Continuous and Cantilever RCC Beams (T-beam and l-Beam) b) RCC Slabs – (Simply supported, Continuous, One way and two way). c) RCC Columns –(Tied columns and Spirally reinforced columns) d) Isolated and combined footings for RC Columns.

Reference/Text Books:

1. AutoCAD Book: Command on AutoCAD by Junaid Khan COI Daily Planner to Do List Notepad - Undated Day Planner Note Pad - Work .
2. Planner, Calendar, Scheduler, Checklist, Productivity Organizer, Cute Office Supplies Set of 6 by COI.
3. Autocad with Lab Applications by Shannon Kyles.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3)External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Understand the introduction & history of auto cad software.	**L4**
CO-2	Remember the auto cad software command for engineering purpose.	**L3**
CO-3	To examine the drawing parameter of double line plan for different types of building.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
CAD Lab(RTCE-243P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	0	2	1	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	3	3	1	0	0	0	0	0	0	2	1
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	1

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IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: UG(R) **Class: B.Tech CE**			**Year: II** **Semester: IV**
Credits: 2		**Category**	**Core**
Theory	**Practical**	**Course Code**	**RTCE-241P**
NA	**2**	**Course Name**	**Fluid mechanics lab**

Course Objectives:
1. To verify the Bernoullis equation.
2. To determine the coefficient of discharge of venturimeter Modelling
3. To determine the coefficient of discharge of rectangular notch.
4. To determine the coefficient of discharge of rectangular notch
5. To determine co-efficient of discharge, contraction & velocity of an orifice

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	**T :** 0	**P :** 2	**C :** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	To verify the Bernoullis equation.
Practical-2.	To determine the coefficient of discharge of venturimeter.
Practical-3.	To determine the coefficient of discharge of rectangular notch
Practical-4.	To determine the coefficient of discharge of rectangular notch
Practical-5.	To determine co-efficient of discharge, contraction & velocity of an orifice.
Practical-6.	To determine head loss in pipe (Expansion, Contraction and Bend)
Practical-7.	To determine the meta centric height of a floating body
Practical-8.	To study the variation of friction factor, „f‟ for turbulent flow in commercial pipes.
Practical-9.	To find a critical Reynold‟s number for a pipe flow

Reference/Text Books:
1. Fluid Mechanics and Hydraulic Machines Lab Manual by Damodara Reddy Annapureddy
2. Micro- and Nanoflows: Modeling and Experiments: 118 (Fluid Mechanics and Its Applications) by Valery Ya. Rudyak, Vladimir M. Aniskin, et al
3. Speckle Photography for Fluid Mechanics Measurements (Experimental Fluid Mechanics) by Nikita A. Fomin |
4. Fluid Mechanics and Hydraulic Machines: A Lab Manual by T.S. Desmukh

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	To understand the basic movement of fluid flow.	**L4**
CO-2	To learn the use of fluid machinery in the field of fluid mechanics	**L3**
CO-3	To get the knowledge about fluid flow through momentum and continuity equations.	**L2 & L3**
CO-4	To determine the different properties of fluid by fluid machinery	
CO-5	Determine the properties of different kinds of jump in hydraulics and fluid flow.	

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Fluid Mechanics Lab(RTCE-241P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	0	2	1	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	3	3	1	0	0	0	0	0	0	2	1
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	1

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IIMTU-NEP IMPLEMENTATION
Year: III / Semester: 5

B.Tech Civil Engineering (Year: III / Semester: V)		
SECE-351	**GEOTECHNICAL ENGINEERING**	**L4 T1 2P C4**
Course Objectives:	The objectives of studying this course are,	
1.	To understand the Classification of the soil and determine its Index properties.	
2.	To evaluate permeability and seepage properties of soil.	
3.	Interpretation of the compaction and consolidation characteristics & effective stress concept of soil.	
4.	To determine the vertical and shear stress under different loading conditions and explain the phenomenon of soil liquefaction.	
5.	Interpret the earth pressure and related slope failures.	
Detailed Syllabus		
Unit-I	**Soil Formation and Composition, Basic Soil Properties** Introduction, soil and rock, Soil Mechanics and Foundation Engineering, origin of soils, weathering, soil formation, major soil deposits of India, particle size, particle shape, antiparticle forces, soil structure, Principle clay minerals. Introduction, three phase system, weight-volume relationships, soil grain properties, soil aggregate Properties, grain size analysis, sieve analysis, sedimentation analysis, grain size distribution curves, Consistency of soils, consistency limits and their determination, activity of clays, relative density of sands.	**8L**
Unit-II	**Origin and classification:** Preview of Geotechnical field problems in Civil Engineering, Soil formation, transport and deposit, Soil composition, Basic definitions, Weight volume relationships, Clay minerals, Soil structure, Index properties, sensitivity and thixotropy, Particle Size analysis, Unified and Indian standard soil classification system.	**8L**
Unit-III	**Compressibility and Consolidation** **Introduction**-components of total settlement, consolidation process, one-dimensional consolidation test, typical void ratio-pressure relationships for sands and clays, normally consolidated and over consolidated clays, Casagrande`s graphical method of estimating pre-consolidation pressure, Terzaghi`s theory of one-dimensional primary consolidation, determination of coefficients of consolidation, consolidation settlement, Construction period settlement, secondary consolidation	**8L**

Unit-IV	**Soil Hydraulics:** Stress conditions in soil- total, effective and neutral stresses and relationships. Permeability - Darcy's Law, hydraulic conductivity, equivalent hydraulic conductivity in Stratified soil. Seepage, flow nets, seepage calculation from a flow net, flow nets in anisotropic Soils, seepage through earth dam, capillarity, critical hydraulic gradient and quick sand condition, Uplift pressure, piping.	**8L**
Unit-V	**Shear Strength:** Mohr-Coulomb failure criterion, shear strength parameters and determination; Direct and tri-axial shear test; unconfined compression test; pore pressure, Skempton's pore Pressure Coefficients. Earth pressure: Classical theories, Coulomb and Rankine's approaches for Frictional and c- φ soils, inclined backfill, Stability of slopes, Culman method & Method of slices, Stability number & chart.	**9L**
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	To learn a rational adulthood to the undergraduate for the courses in field of Geotechnical Engineering & Soil enhancement Technologies.	**K1**
CO-2	To understand the foundations of soil classifications to the students related to the geotechnical engineering.	**K2**
CO-3	To give an experience in the commission of engineering concepts which are applied in area of Geotechnical Engineering?	**K3**
CO-4	To analyze the stress conditions in the soil stratum.	**K4**
CO-5	To check the different types of pressure on the soil and collect the information of foundation design.	**K5**
Text Books:		
1.	Thomas H. Coreman, Charles E. Leiserson and Ronald L. Rivest, "Introduction to Algorithms", Printice Hall of India.	
2.	E. Horowitz & S Sahni, "Fundamentals of Computer Algorithms",	
3.	Aho, Hopcraft, Ullman, "The Design and Analysis of Computer Algorithms" Pearson Education, 2008.	
Reference Books:		
1.	V.N.S. Murthy – Soil Mechanics and Foundation Engineering (Fifth Edition)	
2.	K.R. Arora – Soil Mechanics and Foundation Engineering	
3.	Narasinga Rao, B.N.D, "Soil Mechanics & Foundation Engineering", John Wiley & Sons, Wiley India Pvt. Ltd., Daryaganj, New Delhi – 110 002..	

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IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

B.Tech Civil Engineering (Year: III / Semester: V)		
SECE-352	**STRUCTURAL ANALYSIS**	**L4 T1 2P C4**
Course Objectives:	The objectives of studying this course are,	
1.	To understand the principle of virtual work and the application of influence line diagrams in structural analysis problems.	
2.	The course runs through a number of techniques which are used for the analysis of civil engineering structures.	
3.	Explain type of structures and method for their analysis. .	
4.	Compute slope and deflection in determinate structures using different methods.	
5.	To understand about the plastic analysis.	
Detailed Syllabus		
Unit-I	**Classification of Structures**: Types of structural frameworks and Load transfer Mechanisms, stress resultants, degrees of freedom, Static and Kinematic Indeterminacy for beams, trusses and building frames. **Suspension Cables:** Analysis of suspension cables with concentrated loading & continuous loading,	**8L**
Unit-II	**Trusses:** Classification of Pin jointed determinate trusses, Analysis of determinate plane trusses. **Influence line diagrams**: Rolling loads and influence line diagrams for determinate beams and trusses, Absolute maximum bending moment and shear force. Muller-Breslau's principal & its applications for determinate	**8L**
Unit-III	**Moment Distribution Method:** Distribution and carry-over of moments, Stiffness and carry over factors - Analysis of continuous beams with sinking of supports, single storey Portal frames with and without sway. Slope deflection method as applied to indeterminate beams & continues beams portal frames.	**8L**
Unit-IV	**Columns and Struts:** Types of column, Buckling of columns, different end conditions, effective length, Euler's and Rankine's formulae, Factor of safety. Strain Energy of deformable systems	**8L**
Unit-V	**Basics of plastic analysis:** Applications of static and kinematic theorem for Plastic analysis of Beams and Frames	**9L**
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	To define the types of structure and their analysis methods.	**K1**
CO-2	To know the behavior of ILD and truss and calculated the forces on their member.	**K2**
CO-3	Analyze the slope and deflection in structure by using different methods.	**K3**
CO-4	To evaluate the column buckling in structures with different end	**K4**

	conditions.	
CO-5	check the behavior of plastic analysis for beam and frame.	**K5**
Text Books:		
1.	Hibbler, "Structural Analysis", Pearson Education	
2.	"Theory of structures" by Dr. B C Punamia, Laxmi Publications (P) Ltd.	
3.	Timoshenko & Young "Theory of Structure" Tata Mc Grew Hill.	
Reference Books:		
1.	Jain, O.P. and Jain, B.K., "Theory & Analysis of Structures". Vol-.I & II , Nem Chand.	
2.	Wilbur and Norris, "Elementary Structural Analysis", Tata McGraw Hill.	
3.	Reddy, C.S., "Basic Structural Analysis", Tata McGraw Hill.	

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IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

B.Tech Civil Engineering (Year: III / Semester: V)		
SECE-353	**Design of concrete structure-I**	**L4 T1 0P C4**
Course Objectives:	The objectives of studying this course are,	
1.	Understand the behavior of RCC material and design philosophies criteria	
2.	Analyse and Design RCC beams for flexure by IS methods.	
3.	Analyse and Design RCC beams for shear by IS methods.	
4.	Analyse and Design RCC slabs and staircase by IS methods.	
5.	Design the RCC compression members by IS methods.	
Detailed Syllabus		
Unit-I	Concrete Making materials, Properties of concrete and reinforcements, testing of concrete, Introduction to Various Design Philosophies, Design of Rectangular Singly and Doubly Reinforced Sections by Working Stress	**8L**
Unit-II	Assumptions in Limit State Design Method, Design of Rectangular Singly and Doubly Reinforced beams, T-beams, L-beams by Limit State Design	**8L**
Unit-III	Behaviors of RC beam in Shear, Shear Strength of beams with and without shear reinforcement, Minimum and Maximum shear reinforcement, design of beam in shear, Introduction to development length, Anchorage bond, and flexural bond. (Detailed Examples by Limit State Design Method), Failure of beam under shear, Concept of Equivalent Shear and Moments.	**8L**
Unit-IV	Design of one way and two way solid slabs by Limit State Design Method, Serviceability Limit States, Control of deflection, cracking and vibrations.	**8L**
Unit-V	Design of Columns by Limit State Design Method- Effective height of columns, Assumptions, Minimum eccentricity, Short column under axial compression, requirements for reinforcement, Column with helical reinforcement, Short column under axial load and uni-axial bending, Design of columns under bi-axial loading by Design Charts.	**9L**
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	To learn the properties of the concrete used for the construction of different structural member.	**K1**
CO-2	To understand about the analyzing methods like LSM and WSM.	**K2**
CO-3	To use the concept of development length and stirrups.	**K3**
CO-4	To learn the designing of various structural member like slab foundation and beam etc.	**K4**
CO-5	To check the stability of columns.	**K5**
Text Books:		
1.	IS: 456 – 2000, " Code of Practice for Plain and Reinforced Concrete", Bureau of Indian Standards, New Delhi.	
2.	Jain, A.K., "Reinforced Concrete: Limit State Design", Nem Chand & Bros., Roorkee.	

3.	Gambhir, M L ,"Fundamentals of Reinforced Concrete", Prentice Hall of India.
Reference Books:	
1.	Unnikrishna Pillai, S. & D. Menon, " Reinforced Concrete Design", Tata Mc-Graw Hill Company Limited
2.	Jain, O. P. & Jai Krishna, " Plain and Reinforced Concrete", Vol. I & II, Nem Chand & Bros., Rookee.
3.	Park, R. and T. Pauley," Reinforced Concrete Structures", John Wiley & Sons.

Note: 1. all designs shall be conforming to IS: 456 – 2000.

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IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

B.Tech Civil Engineering (Year: III / Semester: V)		
SECE-351P	**GEOTECHNICAL ENGINEERING LAB**	**L T P2 C1**
Course Objectives:	The objectives of studying this course are,	
1.	Determine the water content of soil by different method.	
2.	Determine the specific gravity and density of soil.	
3.	Determine the grain size of soil sample.	
4.	Determine the limits of soil sample.	
5.	Determine the moisture and shrinkage in soil.	
Detailed Syllabus		
Practical-1	Determination of water content of a given moist soil sample by (i) oven drying	
Practical-2	Determination of specific gravity of a given soil sample by (i) density bottle, (ii)	
Practical-3	Determination of in situ dry density of soil mass by (i) core-cutter method, (ii) sand	
Practical-4	Determination of relative density of a given soil sample.	
Practical-5	Determination of complete grain size distribution of a given soil sample by sieve	
Practical-6	Determination of consistency limits (liquid, plastic and shrinkage limits) of the soil	
Practical-7	Determination of shear strength of soil by Direct shear test.	
Practical-8	Determination of compaction characteristics (OMC & MDD) of a given soil sample.	
Practical-9	To determine the moisture content of soil using Hydrometer.	
Practical-10	To determine the Shrinkage limit of the given Soil Sample.	
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	The undergraduate will gain the knowledge in the discharge of Geotechnical Engineering on engineering concepts which are applied in area of Geotechnical Engineering.	**K1**
CO-2	To understand the water content and specific gravity determination.	**K2**
CO-3	The students will get theoretical and practical knowledge of geotechnical engineering along with the design and implementation through applications.	**K3**
CO-4	To analyze the liquid, plastic and shrinkage limits of soil.	**K4**
CO-5	To determine the water content through the laboratory experiments.	**K5**
Text Books:		
1.	Soil Mechanics Lab Manual by Michael E. Kalinski	
2.	Soil Mechanics Laboratory Manual by Braja M Das	
3.	Basic And Applied Soil Mechanics by Gopal Ranjan	
Reference Books:		
1.	A Laboratory Manual on Soil Mechanics (Testing and Interpretation) by Ravi Kumar Sharma	
2.	Soil Mechanics: Solutions Manual by R. F Craig	
3.	Methods in Soil Biology (Springer Lab Manual) by Franz Schinner, Richard Öhlinger, et al.	

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

B.Tech Civil Engineering (Year: III / Semester: V)		
SECE-352P	**STRUCTURAL ANALYSIS LAB**	**L T P2 C1**
Course Objectives:	The objectives of studying this course are,	
1.	To study the determination of flexural rigidity.	
2.	To study the determination of horizontal thrust in two hinge & three hinge arch.	
3.	To study the determination of bending moment.	
4.	To study the determination of critical load in strut.	
5.	To study the determination of deflection.	
Detailed Syllabus		
Practical-1	To determine Flexural Rigidity (EI) of a given beam	
Practical-2	To verify Maxwell's Reciprocal theorem.	
Practical-3	To find horizontal thrust in a three-hinged arch and to draw influence line diagrams	
Practical-4	To find horizontal thrust in a two hinged arch and to draw influence line diagrams for	
Practical-5	To find deflection of curved members.	
Practical-6	To find bar forces in a three members structural frames with pin jointed bar	
Practical-7	To find Critical load in Struts with different end conditions.	
Practical-8	To find deflections in Beam having unsymmetrical bending.	
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	Understand the behavior of deflection at any point.	**K1**
CO-2	Examine the horizontal thrust for two and three hinged arch.	**K2**
CO-3	Draw influence line diagram of horizontal thrust and bending moment for two & three hinged arch.	**K3**
CO-4	Analyze the deflection on simple beam and curved beam.	**K4**
CO-5	To evaluate the critical load in strut with different end condition.	**K5**
Text Books:		
1.	Protein Structure Analysis: Preparation, Characterization, and Micro sequencing (Springer Lab Manuals) by Roza Maria Kamp, Theodora Choli-Papadopoulou, et al.	
2.	Matrix Methods of Structural Analysis by S.S. Bhavikatti	
3.	Workbook and Lab Manual for Sonography - E-Book: Introduction to Normal Structure and Function **by Reva Arnez Curry**	
Reference Books:		
1.	Piling Engineering by Ken Fleming, Austin Weltman, et al.	
2.	Dynamic Response of Infrastructure to Environmentally Induced Loads: Analysis, Measurements, Testing, and Design (Lecture Notes in Civil Engineering Book 2) **by Anastasios G. Sextos and George D. Manolis.**	
3.	Workbook and Lab Manual for Sonography: Introduction to Normal Structure and Function (Old Edition) by Reva Arnez Curry PhD RDMS RTR FSDMS and Betty Bates Tempkin BA.	

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IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

B.Tech Civil Engineering (Year: III / Semester: V)		
SECE-353P	**BPD LAB**	**L T P2 C1**
Course Objectives:	The objectives of studying this course are,	
1.	To study the use of symbols in civil engineering drawing.	
2.	To learn the size of building components.	
3.	To lean the planning of building drawing.	
4.	To learn the planning of elevations.	
5.	To learn the preparation of building layout of different types building.	
Detailed Syllabus		
Practical-1	Symbols used in Civil Engineering drawing, Types of Masonry Bonds	
Practical-2	Doors, Windows and staircases.	
Practical-3	Plumbing & Electrical fitting drawings	
Practical-4	Comprehensive Planning and Drawings of Residential building (Layout, plan,	
Practical-5	Preparation of Layout plans of different types of Civil Engg. Projects.Viz Primary	
Practical-6	Preparation of plan of pipe fitting in a building.	
Practical-7	Draw the plan of building.	
Practical-8	Make 3D plan of building.	
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	To learn about the building components, principles, methods, and software's for making.	**K1**
CO-2	To apply mastery of various building components like window and doors in structure.	**K2**
CO-3	To made a planned detailed addressed drawing of a building on paper sheet.	**K3**
CO-4	Analyze the planned drawing sheet and advice involved in planning and drawing of building.	**K4**
CO-5	Make the different plans of different types of buildings components.	**K5**
Text Books:		
1.	Building Planning And Drawing by M.V. Chitawadagi S.S. Bhavikatti	
2.	Dating Buildings and Landscapes with Tree-Ring Analysis: An Introduction with Case Studies by Darrin L. Rubino and Christopher Baas	
3.	Approaching Urban Design: The Design Process (Introduction To Planning Series) by Marion Roberts , Clara Greed, et al.	
Reference Books:		
1.	Better by Design: An Introduction to Planning, Designing and Developing Library Buildings by Ayub Khan and Stella The bridge	
2.	Organizational Planning and Analysis: Building the Capability to Secure Business Performance by Rupert Morrison	

3.	The State-Society/Citizen Relationship in Security Analysis: Implications for Planning and Implementation of U.S. Intervention and Peace/State-building Operations by Strategic Studies Institute and Yannis A. Stivachtis

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

B.Tech Civil Engineering (Year: III / Semester: V)		
SECE-351	**Urban transportation planning**	**L3 T1 P C4**
Course Objectives:	The objectives of studying this course are,	
1.	To understand the basics principles of transportation.	
2.	To study the urban transportation planning &processes.	
3.	To study the behavior transport network.	
4.	To use the laboratory concepts for solving the problems related urban transportation.	
5.	To study the evaluation of transport planning.	
Detailed Syllabus		
Unit-I	Introduction and scope; Definition and basic principles; Transportation problems; Types of models; Planning methodologies; Conventional transportation planning process; Travel demand modeling and forecasting;	**8L**
Unit-II	Urban Transportation Planning Process, Urban Travel and Transportation Systems Characteristics, Travel Demands Forecasting-trip generation, trip distribution, modal split and trip assignment.	**8L**
Unit-III	Transport Behavior of Individuals and Households, Land use/ Transportation systems, Traffic Assignment - route building, capacity restraint, multipath, incremental and equilibrium assignment; Graph theory applications in transport network analysis;	**8L**
Unit-IV	Laboratory Component: Solving case study problems in travel demand modeling with the help of transportation planning and econometric packages. Developing computer programs for the calibration of travel demand, land-use	**8L**
Unit-V	Evaluation of transport planning proposals: Land Use Transport Planning, Economic Evaluation methods like Net present Value methods, Benefit Cost method, Internal rate of return method, Land use transport models. Transport system management: Long term and short term planning.	**9L**
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	Study about the modeling and travel forecasting demand.	**K1**
CO-2	Identify the role of transportation in urban areas.	**K2**
CO-3	To compute the network theory for transportation system.	**K3**
CO-4	To analyze the problems of traveling demand of transportation.	**K4**
CO-5	Evaluate the planning of transport rate.	**K5**
Text Books:		
1.	Oppenheim, N., Urban Travel Demand Modeling: From Individual Choices to General Equilibrium, Wiley, New York, 1995.	
2.	Thomas, R., Traffic Assignment Techniques, Avebury Technical, Aldershot, 1991.	
3.	Bruton, M.J., Introduction to Transportation Planning,	
Reference Books:		
1.	Hutchinson, B.G., Principles of Urban Transport Systems Planning, McGraw Hill, New York, 1974.	

2.	Ortuzar, J. and Willumsen, L.G., Modelling Transport, Wiley, Chinchestor, 1994.
3.	Introduction to Transportation Engineering: William W. Hay.

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IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

B.Tech Civil Engineering (Year: III / Semester: V)		
SECE-352	**Pavement Design**	**L3 T1 P C4**
Course Objectives:	The objectives of studying this course are,	
1.	To study latest methods of analysis and design of flexible and rigid pavements including its maintenance	
2.	To understand the behavior of different pavement materials	
3.	To predict stresses developing in flexible and rigid pavements	
4.	To study the design, testing and evaluation of pavements.	
5.	To study the maintenance criteria of pavement.	
Detailed Syllabus		
Unit-I	Pavement Materials :Types and component parts of pavements, highway and airport pavements, Materials used in pavements, basic soil properties relevant to pavement applications, resilient modulus, and modulus of sub-grade reaction, Physical properties: Aggregates and blending, Basic properties of bitumen, polymer and rubber modified bitumen, Dynamic modulus, flow time and flow number of bituminous mixes. Cement: chemical composition, types, physical properties	**8L**
Unit-II	**Stresses in flexible pavements:** layered system concepts, stress solution for one, two and three layered systems, fundamental design concepts. Stresses in rigid pavements: Westergaard's theory and assumptions, stresses due to curling, stresses and deflections due to loading, frictional stresses, stresses in dowel bars and tie bars. **Factors Affecting Pavement Design:** Variables considered in pavement design, Classification of axle types, articulated commercial vehicles, legal axle and gross weights on single and multiple units, tyre pressure, contact pressure, ESWL, EWLF and EAL concepts, Traffic analysis: ADT, AADT, growth factor, lane distribution, directional distribution and vehicle damage factors.	**8L**
Unit-III	**Pavement testing and evaluation** : Field Density, CBR, Plate load Test, Condition surveys and surface evaluation for unevenness, rut depth, profilometers, Bump integrators, Benkalman Beam Deflection study.	**8L**
Unit-IV	**Design of Pavements:** IRC method of flexible pavement design, Design of flexible pavements for low volume roads using IRC method, IRC methods of rigid pavement design, Design of rigid pavements for low volume roads using IRC method.	**8L**
Unit-V	**Strengthening of pavements:** Repairs, Maintenance and rehabilitation of pavements	**9L**
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	To understand the different types of pavement materials and their properties.	**K1**
CO-2	To learn the stress distribution in the pavement.	**K2**
CO-3	To do the pavement testing and evaluations.	**K3**

CO-4	Students have to design the flexible pavement.	**K4**
CO-5	Undergraduate should be able to do the Repairs, Maintenance and rehabilitation of pavements.	**K5**
Text Books:		
1.	Khanna & Justo, Highway Engineering, 10th Edition, Nem Chand Brothers,	
2.	Huang, Y.H. Pavement Analysis and Design, Second Edition, Dorling Kindersley (India) Pvt. Ltd., New Delhi, India, 2008	
3.	Economy of design of bituminous and concrete pavements by S.N. Sachdeva	
Reference Books:		
1.	IRC: 37-2012 Guidelines for the Design of Flexible Pavements, The Indian Roads Congress, New Delhi, India, 2012.	
2.	IRC: 58-2011 Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, The Indian Roads Congress, New Delhi, India, 2011.	
3.	IRC: SP: 62-2004 Guidelines for the Design and Construction of Cement Concrete Pavements for Rural Roads, The Indian Roads Congress, New Delhi, India, 2004.	

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

B.Tech Civil Engineering (Year: III / Semester: V)		
SECE-353	**Hydrology**	**L3 T1 P C4**
Course Objectives:	The objectives of studying this course are,	
1.	Contributed to the development of government civil engineering projects. Private or other companies within the sector.	
2.	Explain the importance of hydrological processes and associated spatiotemporal scales.	
3.	Quantify them by expressing them using mass and energy balance and estimate them based on statistical techniques and systems approaches.	
4.	To characterize the hydro graph and find out many constant for designing.	
5.	To understand the importance of ground water.	
Detailed Syllabus		
Unit-I	Introduction: hydrologic cycle, water budget equations, And world water balance, Precipitation: Forms of precipitation, measurement, depth-area-duration & intensity- duration- frequency relationships, probable maximum precipitation.	**8L**
Unit-II	Abstraction from Precipitation: Evaporation – process, measurement and estimation; Evapotranspiration-measurement and estimation; Initial Losses- Interception & Depression storage; Infiltration-process, capacities indices, measurement & estimation.	**8L**
Unit-III	Runoff and Hydrographs: Hydrograph, runoff characteristics of stream, Yield, Rainfall-runoff correlations, flow duration curve, mass curve, droughts and floods. Factors affecting flood hydrographs, unit hydrograph and its analysis, s-curve hydrograph, synthetic and instantaneous unit hydrographs.	**8L**
Unit-IV	Flood: Rational method, empirical formulae, unit hydrograph method, flood frequency studies, statistical analysis, regional flood frequency analysis, design storm & design flood, risk/reliability and safety factor; Flood Routing: Basic equation, hydrologic storage routing & attenuation, hydrologic channel routing, flood forecasting & control, hydraulic method of flood routing.	**8L**
Unit-V	Groundwater: introduction, forms of subsurface water, aquifers & its properties, Compressibility of aquifers, flow equations for confined and unconfined aquifers, well hydraulics- steady and unsteady flow to a well in confined aquifer, well losses, specific capacity, ground water irrigation, rain water harvesting.	**9L**
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	To define hydrology and explain the water cycle in the context of engineering hydrology.	**K1**
CO-2	To understand about an introduction to the sector of engineering hydrology.	**K2**

CO-3	To compute the area runoff, which is important for any hydrological work.	**K3**
CO-4	To explain the well knowledge about ground water recharge.	**K4**
CO-5	To interpret hydrologic flood routing models for recharging through rain water harvesting.	**K5**
Text Books:		
1.	'Hydrology for Engineers' by Linsley R. K., Kohler M. A. and Paulhus J. L. H.	
2.	'Engineering Hydrology' by K. Subramanya, Mc Graw Hill Education	
3.	'Hydrology: Principles. Analysis. Design' by Raghunath H. M.	
Reference Books:		
1.	'Handbook of Applied Hydrology' by Chow V. T. , Mc Graw Hill Education	
2.	'Irrigation: Theory & Practice' by Michael A. M.	
3.	'Engineering Hydrology' by Ojha, Oxford University Press.	

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IIMTU-NEP IMPLEMENTATION
Year: III / Semester: V

B.Tech : Civil Engineering (Vth Semester/3rd Year)		
SDCE-354	**Estimating and costing**	**4L 1T P 3C**
Course Objectives:	The objectives of studying this course are,	
1.	Objective of this course to guidance of students in quantity surveys for the preparation of preliminary and detailed estimates.	
2.	Teach students how to analyze the cost of the above items for estimation purposes.	
3.	Specification is very important for any civil engineering work.	
4.	To teach how we can find out the rate of analysis of construction materials.	
5.	The main purpose is to provide the effort for cost control and to ensure that suitable material options are considered during project execution.	
Detailed Syllabus		
Unit-I	**Estimate :** Principle of estimation, units, item work, different kinds of estimates, different methods of estimation, estimation of materials in single room building, two room building, multi storey buildings, with different sections of walls ,foundation, floors and roofs, R.B and R.C.C works, Plastering, white washing, Distempering and painting, doors and windows, lump sum items, Estimates of canals, dams, barrages, Hilly roads etc.	**8L**
Unit-II	**Specification of Works:** Necessity of specification types of specification, general specification, specification of bricks, cement, sand, water, lime, reinforcement, detailed specification for earthwork, cement, concrete, brickwork, flooring, D.P.C, R.C.C, cement plastering, white and colour washing, distempering, painting.	**8L**
Unit-III	**Rate analysis** Purpose, importance and requirements of rate analysis, units of measurement preparation of rate analysis. Procedure of rate analysis for items: Earth work, concrete works, R.C.C works, reinforce brick work, plastering, painting ,finishing (white washing, distempering)	**8L**
Unit-IV	**Public Works Account** Tender and acceptance of tender, Earnest money, security money, retention money, measurement book, cash book, preparation, examination and payment of bills, first and final bills, administrative sanction, technical sanction.	**8L**
Unit-V	**Billing:** maintenance of muster role, preparation of pay bill, measurement of work for payment of contractors. Different types of payment: first & final, running advance and final payment. Valuation: Purpose of valuation, principles of valuation depreciation, sinking fund, salvage & scrap value, valuation of a building: cost method, rental –return method.	**8L**
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	To understand the method of estimating and costing.	**K1**
CO-2	To analyze the charges for each item to create a quote.	**K2**

CO-3	To evaluate the quantity of construction material.	**K3**
CO-4	To explain the good knowledge about construction material.	**K4**
CO-5	To define the knowledge about public work accounts like contract, tenders etc.	**K5**
Text Books:		
1.	Dutta BN, Estimating & costing.	
2.	Rangwala SC Estimating & Costing, Anand Charotar Book Stall.	
3.	Chakraborty, Estimate costing & specification in Civil Engineering.	
Reference Books:		
1.	Kohli & Kohli, A text book on estimating & costing (Civil) with drawings Ambala Ramesh Publications.	
2.	Srivastava, U.K., "Construction Planning and Management", Galgotia Publications Pvt. Ltd., New Delhi.	
3.	Delhi Schedule of Rates (latest version).	

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IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

B.Tech Civil Engineering (Year: III / Semester: VI)		
SECE-361	**Environmental Engineering**	**L3 T1 P C4**
Course Objectives:	The objectives of studying this course are,	
1.	Assess water demand and optimal size of water mains.	
2.	Layout the distribution system & assess the capacity of reservoir.	
3.	Investigate physical, chemical & biological parameter of water.	
4.	Design treatment units for water and waste water.	
5.	Apply emerging technologies for treatment of waste water.	
Detailed Syllabus		
Unit-I	**Overview of Data Communication and Networking:** Fresh water, water demands, variation in demands, population forecasting by various methods, basic needs and factors affecting consumption, design period. Transmission of water: Various types of conduits, capacity and sizes including economical sizes of rising main, structural requirements; laying and testing of water supply pipelines; pipe materials, joints, appurtenances and valves; leakages and control.	**8L**
Unit-II	Storage and distribution of water: Methods of distribution, pressure and gravity distribution systems, Concept of service and balancing reservoirs. Capacity of distribution reservoirs: general design guidelines for distribution system.	**8L**
Unit-III	Physical, chemical and bacteriological examination of water and wastewater: Temperature, pH, colour and odour, solids, nitrogen and phosphorus, chlorides, toxic metals and compounds, BOD, COD etc. quality requirements, standards of water and waste water, disposal of wastewater on land and water bodies.	**8L**
Unit-IV	Objectives of water treatment: unit operations, processes, and flow sheets. Water treatment: screening, sedimentation, determination of settling velocity, efficiency of ideal sedimentation tank, design of settling tanks, grit chamber. Primary sedimentation and coagulation, filtration: theory of filtration; hydraulics of filtration; slow sand, rapid sand and pressure filters, backwashing; design of slow and rapid sand filters. Disinfection: requirements of an ideal disinfectant; various disinfectants, chlorination and practices of chlorination, water softening and ion-exchange process.	**8L**

Unit-V	Objectives of waste water treatment: unit operations, processes, and flow sheets. Secondary and tertiary treatment: secondary sedimentation and theory of organic matter removal. Working of activated sludge process, trickling filters; aerated lagoons, waste stabilization ponds, oxidation ditches, rotating biological contactors (RBC). Anaerobic digestion of sludge: design of low and high rate anaerobic digesters and septic tank. Working of up flow anaerobic sludge blanket (UASB) reactor and other emerging technologies for wastewater treatment.	**9L**
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	To learn about the water quality properties.	**K1**
CO-2	To understand the storage and distribution of water in the traditional life.	**K2**
CO-3	To get the functional knowledge of BOD and COD.	**K3**
CO-4	Undergraduate should be able to do the treatment of water purification.	**K4**
CO-5	Do the aerobic and anaerobic decomposition of the wastes.	**K5**
Text Books:		
1.	Rangwala S.C., Water Supply & Sanitary Engineering, Charotar Publishing House (P) Ltd.	
2.	Garg S.K., Water Supply Engineering, Khanna Publishers, Delhi.	
3.	Modi P.N., Water Supply Engineering, Standard Book House, Delhi.	
Reference Books:		
1.	Environmental Engineering_ by N N Basak	
2.	Environmental Engineering Water SupplyEngineeringVol.1_by Santosh Kumar Garg	
3.	Textbook of Environmental Engineering_by Rao P.V	

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IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

B.Tech Civil Engineering (Year: III / Semester: VI)		
SECE-362	**Design Of Concrete Structures-II**	**L3 T1 P C4**
Course Objectives:	The objectives of studying this course are,	
1.	To Analyses the stresses in flat slab and design parameter for flat slab.	
2.	To Analyses and design footing.	
3.	To Analyses and design retaining wall.	
4.	To Analyses and design water tank.	
5.	To Analyses the losses in pre-stress beam.	
Detailed Syllabus		
Unit-I	Nature of Stresses in flat slabs with and without drops, coefficient for design of flat slabs, reinforcement in flat slabs. (IS Code Method).	**8L**
Unit-II	Analysis and design of beam curved in plan. Structural behavior of footings, design of footing for a wall and a single column, combined rectangular and trapezoidal footings, Design of strap footing.	**8L**
Unit-III	Structural behavior of retaining wall, stability of retaining wall against overturning and sliding, Design of T-shaped retaining wall, Concept of Counter fort retaining wall. Loads, forces and I.R.C. bridge loadings, Design	**8L**
Unit-IV	Design criteria, material specifications and permissible stresses for tanks, design concept, of circular and rectangular tanks situated on the ground / underground, design of overhead tanks.	**8L**
Unit-V	Advantages of prestressing, methods of prestressing, losses in prestress, analysis of simple prestressed rectangular and T-section.	**9L**
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	Understand the behavior of reinforcement in flat slab.	**K1**
CO-2	Describe the structural behavior of footing and designing parameter of footing.	**K2**
CO-3	Interpret the features of retaining wall and why it is required.	**K3**
CO-4	To organize about the water storage tank and how to design tank as per their capacity.	**K4**
CO-5	Study the behavior of stress on pre-stress member and identify their losses.	**K5**
Text Books:		
1.	IS: 456 – 2000, "Code of Practice for Plain and Reinforced Concrete", Bureau of Indian Standards, New Delhi.	
2.	Jain, A.K., "Reinforced Concrete: Limit State Design", Nem Chand & Bros., Roorkee.	
3.	Dayaratnam, P, "Limit State Design of Reinforced Concrete Structures" Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.	
Reference Books:		

1.	Gambhir, M L,"Fundamentals of Reinforced Concrete", Prentice Hall of India.
2.	Unnikrishna Pillai, S. & D. Menon, "Reinforced Concrete Design", Tata Mc-Graw Hill Company Limited.
3.	Jain, O. P. & Jai Krishna, "Plain and Reinforced Concrete", Vol. I & II, Nem Chand & Bros., Rookee.

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IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

B.Tech Civil Engineering (Year: III / Semester: VI)		
SDCE-361	**Railway and tunnels**	**L3 T1 P C3**
Course Objectives:	The objectives of studying this course are,	
1.	To study the function of railway.	
2.	To study the alignments in railway.	
3.	To study the signal in railway.	
4.	To study the parameter of tunnels.	
5.	To study the ventilation in tunnels.	
Detailed Syllabus		
Unit-I	**INTRODUTION OF RAILWAY** Introduction to Railways, History and Importance of Indian Railways, Rails, Type of rails, rail gauges, permanent way formation,– functions, requirements, sections in embankment and cutting(single/double track), electrified tracks, locomotives, wheel and axle arrangement, coning of wheels, defect in rails, rail fastenings, Fish plates, spikes, chairs, keys, bearing plates. Sleepers, types of sleepers, Requirements of sleeper, sleeper density, ballast: material, specifications.	**8L**
Unit-II	**RAILWAYS ALIGNMENT** Track Geometrics, Turnouts and Crossings, Stations and Yards: Railway alignment, vertical alignment – gradients and grade effects, horizontal alignment – horizontal curves, super-elevation, concepts of cant excess and deficiency, safe permissible speed, transition curves, widening of gauges and track clearances, points and crossings – terminologies, types of turnouts, design of turnouts, types of crossings, design of crossings. Different types of stations and Yards: classification and functioning.	**8L**
Unit-III	**SIGNALS OF RAILWAYS** Signaling and Interlocking, Urban Railways: Classification of Signals, method of train working, absolute block system, Centralized train control system, ATS, interlocking of track, principle of interlocking, types of interlocking, high speed track – track requirement, speed limitations, high-speed technologies, Urban railway- railway system in urban areas.	**8L**
Unit-IV	**INTRODUCTION OF TUNNEL** General: Introduction of Tunnel, Necessity/Advantage of a tunnel, Classification of Tunnels, Size and shape of a tunnel, Alignment of a Tunnel, Portals and Shafts, Problems in Tunneling. Tunneling in Hard Rock: Sequence of operation, Faces of attack, Methods of tunneling in hard rock	**8L**

Unit-V	**VENTILATION & DRAINAGE SYSTEM OF TUNNEL** Tunneling in Soft Ground: Types and factors affecting the choice of method to sort ground, Methods of tunneling in soft rocks Lighting, Ventilation and Dust control: Tunnel Lighting, Ventilation of Tunnel, Methods of Ventilation, Dust control. Drainage and safety: Drainage of tunnel, Drainage system, Safety.	**9L**
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	Understand the history & role of railways in India.	**K1**
CO-2	Identify the alignments of railway and designing criteria.	**K2**
CO-3	To solve the problems of signal system used in railways and urban railway system.	**K3**
CO-4	Differentiate the behavior of tunnel for engineering purpose.	**K4**
CO-5	To evaluate the problems causes of ventilation & drainage system in tunnels.	**K5**
Text Books:		
1.	A Text Book of Railway Engineering by S. P. Arora & S. C. Saxena	
2.	Railway Engineering by M. M. Aggrawal.	
3.	Rock Mechanics Design in Mining & Tunneling by Z T Bieniawski	
Reference Books:		
1.	Railway Engineering by Rangwala (Charotar Publishing House).	
2.	Tunnel Engineering Handbook by J O Bickel & T R Kuesel	
3.	Tunnel Engineering by S.C. Saxena	

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IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

B.Tech Civil Engineering (Year: III / Semester: VI)		
SDCE-362	**Principle of town planning and architecture**	**L3 T1 P C3**
Course Objectives:	The objectives of studying this course are,	
1.	Study the concept of town planning and transportation.	
2.	Study the planning problems in cities.	
3.	Study the architectural development.	
4.	Study the elements of architectural design.	
5.	Study the planning of building as per government rule.	
Detailed Syllabus		
Unit-I	Principles and history of town planning, Comprehensive planning of towns: Contemporary planning concepts, Problems of urban growth. Land use classification and patterns, Housing demographic arid social surveys, economic and environmental aspects. Concept of master plan, Zoning and Density. Transportation network and planning. Planning standards for different land use allocation. Role of town planners.	**8L**
Unit-II	An overview of ancient human settlements, Evolution of towns: Garden city movement, Linear city and concentric city concepts, Neighborhood and Radburn, La-cite industrielle, Radiant city to present day planning, Satellite town concepts. Concept of habitat, Neighborhood planning, problems of metropolis.	**8L**
Unit-III	Factors influencing architectural development. Impact of development of materials and techniques through ages. Evolution of architectural forms. Brief history of architecture.	**8L**
Unit-IV	Elements of Architectural Design: Line. Form, Shape, Space, texture, value and colour. Principles of Architectural Design: Balance, Rhythm, Emphasis, Proportion and Scale, Movement, Contrast, Unity, Harmony, Repetition, Hierarchy. Creation of 2 D and 3 D compositions. Role of architects.	**8L**
Unit-V	Functional planning of buildings: Occupancy classification of buildings, General requirements of site and building. Building codes, Acts and Bye-laws, Licensing of building works. Functional planning of building such as residential, institutional, public, commercial, industrial buildings – identifying activity areas and linkages, checking for circulation, ventilation, structural requirements and other constraints. Different symbols used in building industry as per NBC and preparing sketch plan, working drawing etc.	**9L**
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	To understand the history of the town planning.	**K1**
CO-2	To learn about the ancient settlement of the civilization.	**K2**

CO-3	Use the different materials techniques in civilization.	**K3**
CO-4	Analyze the planning laws, regulations and recommendations involved in planning, building drawings and architectural concepts of buildings.	**K4**
CO-5	Sketch the plans of different kinds of building.	**K5**
Text Books:		
1.	Sir Banister Fletcher's, A History of Architecture, CBS Publisher.	
2.	Percy Brown, Indian architecture (Buddhist and Hindu Period), D. B. Taraporevala Sons & Co., Bombay.	
3.	G.K. Hiraskar, Great Ages of World Architecture, Dhanpat Rai Publications.	
Reference Books:		
1.	Geoffrey Broadbent, Design in Architecture: Architecture and the Human Sciences, John Wiley & Sons, London.	
2.	Arthur Gallion, The Urban Pattern: City Planning & Design, D.Van Nostrand CD. Inc.	
3.	Nelson P. Lewis, Planning to Modern City, Routledge.	

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IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

B.Tech Civil Engineering (Year: III / Semester: VI)		
SDCE-363	**Ground water management**	**L3 T1 P C3**
Course Objectives:	The objectives of studying this course are,	
1.	To recognize groundwater availability and domain names; recharge.	
2.	To introduce to ground development strategies.	
3.	To enhance floor water desk strategies.	
4.	To know about management of a ground water.	
5.	To improve ground water table techniques.	
Detailed Syllabus		
Unit-I	Introduction, hydrological cycle & definitions, Occurrence of ground water, hydro-geology & aquifers, Ground water movement, Darcy's law, flow-nets in isotropic medium.	**8L**
Unit-II	Steady and unsteady flow through confined and unconfined aquifers, Dupuits theory, Observation wells, Well Hydraulics: Single& Multiple well system, partially penetrating wells, Image wells, Mutual interference of wells, well losses, specific capacity, Inverse problem i.e. pumping tests for aquifer	**8L**
Unit-III	Water Wells: Design of water wells, Well construction, Well completion, Development of wells Pumping equipment for water wells, maintenance of wells, ground water irrigation.	**8L**
Unit-IV	Ground Water quality, Contamination of groundwater and its Control, Ground Water Modeling Techniques, Ground water exploration, Surface and Subsurface Investigations of Ground water, Artificial discharge and Recharge of Ground Water, Groundwater drainage,	**8L**
Unit-V	Ground Water Management Techniques: Groundwater budgeting, groundwater modeling & stimulation, application of GIS and remote sensing in groundwater management. Roof- top rainwater harvesting and recharge.	**9L**
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	To know about ground water availability zones and ground water management.	**K1**
CO-2	To Analyze and suggest appropriate soil improvement techniques for problematic ground conditions.	**K2**
CO-3	To apply knowledge of groundwater availability and natural resources for sustainable development with appropriate understanding.	**K3**
CO-4	To explain the phenomenon of groundwater movement.	**K4**
CO-5	To understand how to replenish groundwater reserves.	**K5**
Text Books:		
1.	Groundwater Hydrology by Todd D. K.	
2.	Groundwater Resource Evaluation by Walton W. C.	

3.	Groundwater by Raghunath H. M.
Reference Books:	
1.	Handbook of Applied Hydrology by Chow V. T.
2.	Irrigation: Theory & Practice by Michael A. M.
3.	Groundwater by S.Ramakrishnan

IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

B.Tech Civil Engineering (Year: III / Semester: VI)		
SDCE-364	**Foundation engineering**	**L3 T1 P C3**
Course Objectives:	The objectives of studying this course are,	
1.	To study the soil exploration and geophysical methods.	
2.	To study the soil bearing capacity and design of shallow foundation.	
3.	To design deep foundation.	
4.	To study the use of sheet piles.	
5.	To study the geotechnical properties of reinforced soil.	
Detailed Syllabus		
Unit-I	Introduction to soil exploration, methods of boring and drilling, soil sampling and sampler, in-situ tests, SPT, CPT, DCPT, geophysical methods; soil resistivity methods seismic refraction methods.	**8L**
Unit-II	Bearing capacity of shallow foundation, design criteria, factors affecting bearing capacity, factors influencing selection of depth of foundation, modes of shear failures, types of shallow foundations, contact pressure under rigid and flexible footings, Terzaghi's, Meyerhof, Hansen's bearing capacity theories, IS code method Settlement of shallow foundations: components of settlement & its estimation, immediate, consolidation, & differential	**8L**
Unit-III	Design of shallow foundation; principles of design of footing, design of isolated footings and strip footing. Deep foundation; introduction, necessity of deep foundations, pile installation, pile groups, group action of piles in sand and clay, group efficiency of piles, settlement of piles, negative skin friction, single and double under reamed piles.	**8L**
Unit-IV	**Introduction** shapes and characteristics of wells, components of well foundation, forces acting on well foundation, sinking of wells, causes and remedies of tilts and shifts. Retaining walls: introduction, types of retaining structures, support systems for flexible retaining walls (struts, anchoring), construction methods, introduction and uses of sheet piles.	**8L**
Unit-V	Geotechnical properties of reinforced soil, use of soil reinforcement, shallow foundation on soil with reinforcement, design considerations, idealized soil, and foundation and interface behaviour, elastic models of soil behaviour.	**9L**
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	Understand the soil exploration & soil extraction from land for testing.	**K1**
CO-2	Identify the soil bearing capacity and design parameter of shallow foundation.	**K2**
CO-3	To solve the problems of deep foundation.	**K3**
CO-4	To classify the characteristics of well foundation & retaining wall.	**K4**
CO-5	To evaluate the geotechnical properties and concept of soil reinforcement.	**K5**
Text Books:		
1.	Alamsingh; Soil Mechanics & Foundation Engineering; CBS Publishers & Distributors, Delhi	

2.	Taylor D.W.; Fundamentals of Soil Mechanics; Asia Publishing House, Mumbai
3.	Das Braja M; Principles of Geotechnical Engineering; Thomson Asia Pvt. Ltd.
Reference Books:	
1.	Joseph E. Bowles: Foundation analysis and design. McGraw-Hill Higher Education
2.	Gopal Ranjan, Rao A.S.R.; Basic and applied soil mechanics; New age int. (p) ltd.
3.	Arora K.R.; Soil Mechanics & Foundation Engineering; Standard Pub., Delhi

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IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

B.Tech Civil Engineering (Year: III / Semester: VI)		
UVE-601	**Universal Human Values & Professional Ethics**	**L2 T1 P C2**
Course Objectives:	The objectives of studying this course are,	
1.	To reinstate the rich cultural legacy and human values of which we are the custodians.	
2.	To focus on professional ethics which are broader indicators of desirable actions vis-à-vis undesirable actions.	
3.	To lay down broader guidelines of values and ethics for internal and external stakeholders.	
4.	To suggest operational guidelines for value-based and ethical practices in the higher educational institutions leading to implementation and monitoring.	
5.	To indicate the outcomes of creating a value-based and ethical culture in HEIs.	
6.	To suggest indicative reinforcement programmes for nurturing human values and ethics in HEIs.	
Detailed Syllabus		
Unit-I	**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education** Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the	**8L**
Unit-II	**Understanding Harmony in the Human Being - Harmony Myself** Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.	**8L**
Unit-III	**Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship** Understanding harmony in the Family- the basic unit of human interaction, Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*; Trust (*Vishwas*) and Respect (*Samman*) as the foundational values of relationship, Understanding the meaning of *Vishwas*; Difference between intention and competence, Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in	**8L**

	relationship, Understanding the harmony in the society (society being an extension of family): *Samadhan*, *Samridhi*, *Abhay*, *Sah-astitva* as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society (*AkhandSamaj*), Universal Order (*Sarvabhaum Vyawastha*)- from family to world family!.	
Unit-IV	**Understanding Harmony in the Nature and Existence - Whole existence as Co-existence** Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.	**8L**
Unit-V	**Implications of the above Holistic Understanding of Harmony on Professional Ethics** Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations.	**9L**
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	The learning process for holistic development	**K1**
CO-2	Impeccable governance	**K5**
CO-3	Effective institutional management	**K3**
CO-4	Well laid system of rewards and chastisement	**K2**
CO-5	Institutional climate where 'rights' enjoy and 'wrongs' are discouraged.	**K5**
Text Books:		
1.	R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.	
2.	PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.	
3.	Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991	
Reference Books:		
1.	The text book R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2	
2.	The teacher's manual R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics – Teachers Manual, Excel books, New Delhi, 2010	
3.	A set of DVDs containing • Video of Teachers' Orientation Program • PPTs of Lectures and Practice Sessions • Audio-visual material for use in the practice sessions	

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IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

B.Tech: Civil Engineering (VI Semester/3rd Year)		
SECE-361P	**Environmental Engineering Lab**	**L T P2 C1**
Course Objectives:	The objectives of studying this course are,	
1.	To learn the determination of turbidity, conductivity and alkalinity.	
2.	To learn the determination of hardness and residual chlorine.	
3.	To learn the determination of suspended particles in water.	
4.	To learn the determination of BOD & COD.	
5.	To learn the determination of quantity of fluoride.	
Detailed Syllabus		
Practical-1	Determination of turbidity and conductivity.	
Practical-2	Determination of pH, alkalinity and acidity.	
Practical-3	Determination of hardness and chlorides.	
Practical-4	Determination of residual chlorine.	
Practical-5	Determination of Total, suspended and dissolved solids.	
Practical-6	Determination of BOD.	
Practical-7	Determination of COD.	
Practical-8	Determination of kjeldahl nitrogen.	
Practical-9	Determination of fluoride.	
Practical-10	Determination of optimum dose of coagulants by Jar Test Apparatus.	
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	Understand and check the quality of water for using purpose.	**K1**
CO-2	Identify the hardness of water.	**K2**
CO-3	To compute the total solid in water.	**K3**
CO-4	To differentiate the demand of BOD & COD.	**K4**
CO-5	To evaluate the optimum dose of coagulant.	**K5**
Text Books:		
1.	Environmental Engineering_ by Howard S. Peavy , Donald R. Rowe, et al.	
2.	Environmental Engineering (Vol. II) Sewage Waste Disposal and Air Pollution Engineering_ by Santosh Kumar Garg	
3.	Khanna's Multi-Choice Questions & Answers in Environmental Engineering_ by O. P. Gupta	
Reference Books:		
1.	Environmental Design Sourcebook: Innovative Ideas for a Sustainable Built Environment_ by Will McLean and Pete Silver	
2.	Environmental Design Sourcebook: Innovative Ideas for a Sustainable Built Environment_ by Will McLean and Pete Silver	
3.	Elements of Environmental Engineering_by Dr. K.N. Duggal	

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IIMTU-NEP IMPLEMENTATION
Year: III / Semester: VI

B.Tech Civil Engineering (Year: III / Semester: VI)		
SECE-362P	**Simulation Lab-I**	**L T P2 C1**
Course Objectives:	The objectives of studying this course are,	
1.	To learn the use of ANSYS & mat lab.	
2.	To learn the use of STAAD PRO software.	
3.	To learn the use of geotechnical software.	
4.	To learn the water distribution system software.	
5.	To learn the use of GIS software.3W2	
Detailed Syllabus		
Practical-1	Working on Latest Version of ANALYSIS SOFTWARE LIKE ANSYS, ADINA,	
Practical-2	Working on Latest Version of DESIGN SOFTWARE LIKE STAAD PRO / STRUDS / SAP / ETAB / STRAP	
Practical-3	Working on Latest Version of GEOTECHNICAL SOFTWARES like GEO-5 /	
Practical-4	Working on Latest Version of Environmental Engineering software for Analysis and Design of water & wastewater treatment and distribution systems (WATER CAD / SEWER CAD / WATER GEM / SEWER GEM /LOOP)	
Practical-5	Working on Latest Version of Transportation Engineering software like MAX ROAD/ Surveying Software.	
Practical-6	Working on Latest Version of GIS software (ARC GIS / ENVI / GEPSY	
Practical-7	Working on Latest Version of Project Management software (PRIMAVEERA / MS	
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	Draw the 2-D & 3-D model on advanced software for structural analysis.	**K1**
CO-2	Analysis and design the structure using Staad-Pro software.	**K2**
CO-3	To compute the geotechnical software for engineering purpose.	**K3**
CO-4	Analysis waste water treatment and distribution system by using software.	**K4**
CO-5	To evaluate the road pattern by using transportation software and use of ARC GIS software.	**K5**
Text Books:		
1.	**Computer Aided Drafting & Modeling Lab by Venugopal**	
2.	Using Primavera 6 (English, Paperback, Al-Saridi Abdelrahman)	
Reference Books:		
1.	Planning Using Primavera SureTrak Project Manager, Version 3.0, Revised 2004 Edition with Updated Workshops by Harris, Paul E	
2.	Exploring Oracle Primavera P6 Professional 18 for Planners and Engineers Prof. Sham Tickoo	

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IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VII

B.Tech Civil Engineering (Year: IV / Semester: VII)		
SECE-471	**DESIGN OF STEEL STRUCTURES**	**L4 T1 0P C4**
Course Objectives:	The objectives of studying this course are,	
1.	To teach students loading and load combinations for the design of steel structures.	
2.	To make the students familiar with the concepts of steel design starting with riveted, welded and boltedconnections and eccentric connections based on IS:800-1984 and IS:800-2007.	
3.	To teach the students design of tension, compression members and flexural members based on IS: 800-2007.	
4.	To teach students beam-column design as a whole for uniaxial and biaxial loading along with elastictheory of buckling of beams and columns.	
5.	To teach students grillage foundation.	
Detailed Syllabus		
Unit-I	**Introduction** Properties of structural steel, Rolled steel sections as per IS specifications, factor of safety. Working-stress design of connections: riveted, welded and bolted connections, design of fillet and butt weld, eccentric connections, efficiency of joints, high tension bolts. Limit state design of Connections: welded and bolted connections, design of fillet and butt weld, eccentric connections, efficiency of joints, high tension bolts.	**8L**
Unit-II	**Tension Member based on IS: 800-2007** Net Sectional Area, Permissible Stress, Design of Axially Loaded Tension Member, Design of Member Subjectedto Axial Tension and Bending.	**8L**
Unit-III	**Design of Compression Member based on IS: 800-2007** Column: Modes of Failure of a Column, Buckling Failure: Euler's Theory, Effective Length, And Slender-ness Ratio.Design of Compression Members, Design of Built-Up Compression Members: Laced and Battened Columns, Design of column splice.	**8L**
Unit-IV	**Design of Column Bases and Grillage foundation** Design of slab base and gusset base and grillage foundation along with its connection with column.	**8L**
Unit-V	**Design of Beam based on IS: 800-2007** **Introduction,** beam type, section classification, lateral stability of beam, lateral torsional buckling of symmetrical section, design strength of beam (Laterally supported and unsupported), shear strength and deflection, web buckling and web crippling.	**9L**
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	Study the behavior of loading on steel structure and design philosophies.	**K1**

CO-2	To design the tension member of steel structure.	**K2**
CO-3	To analyze the design parameter of compression member.	**K3**
CO-4	Differentiate the types of connection member and how design.	**K4**
CO-5	To evaluate the stability of steel structure.	**K5**
Text Books:		
1.	Design of Steel Structures by S.K.Duggal.	
2.	Design of Steel Structures by N. Subramanian, Oxford Publication.	
3.	Design of Steel Structures by Arya and Ajmani, Nem Chand Brothers Roorkee.	
	Reference Books:	
1.	Vajrani V. N., Ratwani M. M. and Mehra H. Design and Analysis of Steel Structures, Oscar Publications.	
2.	Syal I. C. Design of Steel Structures, Standard Publishers Distributors, New DelhiRamchandra, Non LinearAnalysis of Steel Structures, Standard Publishers Distributors.	
3.	Vajrani V. N., Ratwani M. M. and Mehra H. Design and Analysis of Steel Structures, Oscar Publications.	

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IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VII

B.Tech Civil Engineering (Year: IV / Semester: VII)		
SDCE -471	**Solid Waste Management**	**L3 T1 0P C3**
Course Objectives:	The objectives of studying this course are,	
1.	Learn basic concepts of solid waste management, beginning from source generation to waste disposal in a system of municipality organizational structure.	
2.	Develop understanding on various technological applications for processing of waste and their disposals in various ways.	
3.	Acquire knowledge on waste to energy productions in the perspectives of sustainable development.	
4.	Apply basic concepts in hazardous waste management and integrated waste management for urban areas.	
5.	To acquire a fair amount of knowledge on waste characterization and its management practiced in various cities of India. To achieve this objective, students will be taught different case studies reported by previous researchers and technical bodies.	
Detailed Syllabus		
Unit-I	Solid waste: Public health and ecological impacts, Sources and types of solid wastes, material flow and waste generation, Functional elements: Waste generation, storage, collection, Transfer and transport, processing and recovery, disposal.	**7L**
Unit-II	Transportation: handcart, tri-cycle, animal cart, tripper truck, dumper placer, bulk refuse carrier, railroad transport, water transport, conveyors, layout of routes. Engineering system for on-site handling and processing of solid waste: separators, size reduction equipment are, screening equipment's, densification, baling, cubing, pelleting equipment's.	**8L**
Unit-III	Landfilling: Site selection criteria, landfill layout, landfill sections, Occurrence of gases and leachate in landfills: composition and characteristics, generation factors, initial adjustment phase, transition phase, acid formation phase, methane formation phase, maturation phase of gases and leachate, Introduction to engineered landfills.	**8L**
Unit-IV	Composting, types of composting, process description, design and operational consideration of aerobic composting, process description, design and operational consideration of anaerobic composting. Thermal conversion technologies: incineration and pyrolysis system, energy recovery, system. Overview of solid waste management practices in India.	**8L**
Unit-V	Introduction to Hazardous wastes, Definition of Hazardous waste, The magnitude of the problem; Hazardous waste: Risk assessment, Environmental legislation, Characterization and site assessment, Waste minimization and resource recovery, Transportation of hazardous waste, Disposal of hazardous waste.	**8L**
Course	After studying the above course the student will be able to,	**Level**

Outcomes:		
CO-1	Understand the solid waste management concept & identify the solid waste material for public health.	**K1**
CO-2	Apply processing and handling of solid waste.	**K2**
CO-3	Resolve the disposal of solid waste material.	**K3**
CO-4	Check solid waste conversion unit.	**K4**
CO-5	Handling the risk assessment and various hazardous.	**K5**
Text Books:		
1.	Tchobanoglous, G., Theisen, H., & Vigil, S.A; Integrated Solid Waste Management: McGraw Hill, New York	
2.	Solid Waste Engineering, Principle & Management issues by Ven Te Chow	
3.	Bhide, A.D., B.B. Sundaresan, Solid Waste Management in developing countries.	
Reference Books:		
1.	Manual on Municipal solid Waste Management, CPHEEO, Govt. of India.	
2.	Guidelines for Management and Handling of Hazardous wastes MOEF (1991), Govt. of India.	
3.	Datta, M; Waste Disposal in Engineered Landfills, Narosa Publishers, Delhi.	

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IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VII

B.Tech Civil Engineering (Year: IV / Semester: VII)		
SDCE -472	**Earthquake resistance design of structure**	**L3 T1 0P C3**
Course Objectives:	The objectives of studying this course are,	
1.	Earthquake engineering direction enables inside the analysis and designing of these structures which support the weight.	
2.	Its miles a sub-department of civil engineering.	
3.	To offer a coherent development to the students for the guides in quarter of earthquake engineering	
4.	To present the rules of many primary engineering standards associated earthquake Engineering	
5.	to provide an revel in inside the implementation of engineering concepts which can be implemented in field of earthquake engineering	
Detailed Syllabus		
Unit-I	Internal structure of earth, Causes of earthquakes, Seismic waves, Magnitude, Intensity and Energy released, Characteristics of Earthquakes,	**7L**
Unit-II	Response of Structure to Earthquake motion, Modeling of structures, Dynamics of single degree of freedom system,	**8L**
Unit-III	Dynamics of multi degree of freedom system, Idealization of structures, seismic response,	**8L**
Unit-IV	Introduction to earthquake resistant design, Equivalent lateral force method, Response spectrum method, Time history method, Introduction to earthquake resistant brick and masonry buildings.	**8L**
Unit-V	Reinforced Concrete framed buildings, Code provisions. Introduction to machine foundation & its design. Degrees of freedom of a block foundation.	**8L**
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	To understand the phenomena of earthquake.	**K1**
CO-2	To define the introduction to earthquake resistant design.	**K2**
CO-3	To classify the reinforced concrete framed buildings.	**K3**
CO-4	To Assessment the diverse methods to mitigate seismic dangers, for instance liquefaction and ground changes at soft soil websites.	**K4**
CO-5	To explain the knowledge about Perform design using suitable codes of practice.	**K5**
Text Books:		
1.	Introduction to Structural Dynamics - J.M. Biggs	
2.	Elements of Earthquake Engineering - Jai Krishna an A.R. Chandrasekaran	
3.	IS: 1983 - 1984 Criterion for Earthquake Resistant Design.	

Reference Books:	
1.	Structural Dynamics - Theory & computation - Mario Paz.
2.	Dynamics of Structures Theory and Applications to Earthquake Engineering - Anil K. Chopra.
3.	Earthquake Resistant of Design of structures, Agarwal and Srikhande.

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IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VII

B.Tech Civil Engineering (Year: IV / Semester: VII)		
SDCE-473	**Bridge engineering**	**L4 T1 0P C5**
Course Objectives:	The objectives of studying this course are,	
1.	Discuss the IRC standard live loads and design the deck slab type bridges.	
2.	Analyze the box culverts for the given loading and detail the box culverts.	
3.	Design and detail of T-Beam bridges.	
4.	Design and check the stability of piers and abutments.	
5.	Discuss the bridge foundations and prepare the bar bending schedule.	
Detailed Syllabus		
Unit-I	Site selection, various types of bridges and their suitability, loads, forces and IRC bridge loading and permissible stresses, Design of RC bridges under concentrated loads using effective width and Pigeauds Method,	**8L**
Unit-II	Courbon's method of load distribution. Detail design of Reinforced Concrete slab culvert	**7L**
Unit-III	T-beam bridge, box culverts,	**8L**
Unit-IV	Design elements of plate girder, economical section and design.	**8L**
Unit-V	Design of piers, pier caps and Abutments, different types of bearings & its design	**8L**
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	To learn about the site selection and suitability of the bridge construction.	**K1**
CO-2	To understand the load distribution on the RCC bridge.	**K2**
CO-3	Understand the Indian standard specification for bridge design that helps in analysis of bridges.	**K3**
CO-4	To do the evaluation for elements of plate girder, economical section for bridge.	**K4**
CO-5	Design of piers, pier caps and Abutments, different types of bridge bearings.	**K5**
Text Books:		
1.	Essentials of Bridge Engineering by D J Victor	
2.	Limit State Design of Steel Structures by S K Duggal	
3.	Design of steel Structures by Ramchandra	
Reference Books:		
1.	Bridge Engineering by S.Ponnusway	
2.	Principles & Practices of Bridge Engineering by S.P. Bindra	
3.	Bridge Engineering (An integrated Treatise) by V.V. Sastry	

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IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VII

B.Tech Civil Engineering (Year: IV / Semester: VII)		
SDCE-474	**Plastic analysis of structure**	**L3 T1 0P C3**
Course Objectives:	The objectives of studying this course are,	
1.	To impart the principles of plastic structural analysis and behavior of indeterminate structures	
2.	To impart knowledge about Plastic hinge structures.	
3.	To apply Semi Graphical method and Mechanism method.	
4.	To enable the student get Plastic moment distribution for multi-storey and multi-bay frames	
5.	To make the student familiar with Analysis for deflections at collapse.	
Detailed Syllabus		
Unit-I	Introduction, Historical review, plastic failure, plastic moment, capacity of a cross-section, shape factor, concept of load factor.	**8L**
Unit-II	Plastic hinge and collapse Mechanisms. Analysis of beams and frames.	**8L**
Unit-III	Semi Graphical method and Mechanism method.	**8L**
Unit-IV	Plastic moment distribution for multi-story and multi-bay frames.	**8L**
Unit-V	Analysis for deflections at collapse. Effect of axial force and shear.	**8L**
Course Outcomes:		**Level**
CO-1	Study the introduction and history of plastic failure.	**K1**
CO-2	Describe the behavior of beam & frame with plastic hinge and collapse mechanism.	**K2**
CO-3	To solve the problems of semi graphical method.	**K3**
CO-4	Analyze the problems of plastic moment distribution for multi bay & multi storey structures.	**K4**
CO-5	To evaluate the problem of axial force & shear force.	**K5**
Text Books:		
1.	Inelastic Analysis of Structures by M Jirasek & Z P Bazant, John Wiley	
2.	Plastic Analysis and Design of steel structures by M Bill Wong	
3.	Plastic Analysis of Structures by P G Hodge, McGraw Hill B	
Reference Books:		
1.	**Linear Analysis of Thin Walled Plastic Structures by T. H. G. Megson**	
2.	Limit Analysis of Structures at Thermal Cycling: 4 (Mechanics of Plastic Solids) by D.A. Gokhfeld and O.F. Charniavsky	
3.	Plastic Analysis and Design of Steel Structures by M. Bill Wong	

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IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VII

B.Tech Civil Engineering (Year: IV / Semester: VII)		
SECE-471P	**Materials, Testing & Evaluation Lab**	**L T P2 C1**
Course Objectives:	The objectives of studying this course are,	
1.	To understand the aggregate types.	
2.	To learn about how to find out compressive strength of aggregate.	
3.	To make the mixed design of concrete.	
4.	To check the elastic properties of metals.	
5.	To perform the torsional test.	
Detailed Syllabus		
Practical-1	Gradation of coarse and fine aggregates.	
Practical-2	Compressive strength test on aggregates.	
Practical-3	Tests on unmodified bitumen and modified binders with polymers.	
Practical-4	Bituminous Mix Design and Tests on bituminous mixes - Marshall method.	
Practical-5	Different corresponding tests and need/application of these tests in design and quality	
Practical-6	Tensile Strength of materials & concrete composites.	
Practical-7	Tension I - Elastic Behavior of metals & materials.	
Practical-8	Tension II - Failure of Common Materials.	
Practical-9	Torsion test	
Practical-10	Hardness tests (Brinnel's and Rockwell)	
Course Outcomes:	After studying the above course the student will be able to,	**Level**
CO-1	To understand the grading system of fine and coarse aggregate.	**K1**
CO-2	To learn how to find out compressive strength of coarse aggregate.	**K2**
CO-3	To get the functional knowledge of bitumen mixed design.	**K3**
CO-4	Use testing machines for experiments like CTM machine.	**K4**
CO-5	Determine the torsional value of steel through torsional machine.	**K5**
Text Books:		
1.	Laboratory Manual: For The Use Of Students In Testing Materials Of Construction (1912) by Leslie Abram Waterbury	
2.	Laboratory Manual of Testing Materials **by Hatt William Kendrick**	
3.	Laboratory Manual of Testing Materials by Hatt William Kendrick	
Reference Books:		
1.	Performance Assessment, Grade 7: Performance Assessment Student Edition Grade 7 (Collections) by Houghton Mifflin Harcourt |	
2.	Performance Assessment, Grade 9 (Collections) by Houghton Mifflin Harcourt	
3.	Performance Assessment, Grade 12: Performance Assessment Student Edition Grade 12 (Collections)	

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IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

B.Tech Civil Engineering (Year: IV / Semester: VIII)		
SDCE-481	**CPM & PERT**	**L4 T1 0P C4**
Course Objectives:	The objectives of studying this course are,	
1.	The concept of project management exists because it helps assure completion of a project successfully.	
2.	This course covers the basics of project management where students will learn what project management involves and how to approach it successfully.	
3.	This course includes how to break down a complex project into manageable segments and use of effective project management tools and techniques to arrive at solution and ensure that the project meetsits deliverables and is completed within budget and on schedule.	
4.	To understands the knowledge of contracts.	
5.	To understands the knowledge of project management.	
Detailed Syllabus		
Unit-I	Elements of Management and Network Techniques: Project Cycle, Organization, Planning, Scheduling, Monitoring, updating and Management System in Construction.	**8L**
Unit-II	Network Techniques: Bar Chart, Mile stone chart, work break down structure, and preparation of networks. Network techniques like PERT and CPM. In construction Management, Project Monitoring and resource allocations through network techniques.	**8L**
Unit-III	Project Cost Control: Cost Planning, Direct Cost, Indirect Cost, Total Cost Curve, Cost Slope. Time Value of Money, Present Economy studies, Equivalence Concept, financing of projects, Economic comparisons present worth method, Equivalent annual cost method, discounted cash flow method. Depreciation and break even cost analysis of construction projects.	**8L**
Unit-IV	Contract Management: Legal Aspects of Contracts, laws related to contracts, land acquisition, labor safety and welfare, Different types of contracts, their relative advantages and disadvantages, Elements of Tender Preparation, Process of tendering, pre qualifications of contracts, Evaluation of tenders, contract negotiation and award of work, monitoring of contract, settlement of disputes, arbitration and commissioning of project.	**8L**
Unit-V	Equipment Management: Productivity, operational cost, owing and hiring cost. Constriction equipment: Earth moving, Hauling equipment's, Hoisting equipment's, Conveying Equipment's, Concrete Production equipment's, Tunneling equipment's.	**8L**
Course Outcomes:		**Level**
CO-1	Understand the concept of project cycle & scheduling and planning.	**K1**
CO-2	To explain the network techniques of CPM&PERT by various types of bar	**K2**

	chart.	
CO-3	To solve the problems based on time value of money & project cost system.	**K3**
CO-4	Differentiate the role of contractor as per management laws.	**K4**
CO-5	Evaluate the characteristics of equipment management for engineering purpose.	**K5**
Text Books:		
1.	Robert L. Peurifoy, Clifford J., Schexnayder, Aviad Shapira "Construction Planning Equipment and Methods" McGraw Hills Education (India), Private Ltd., New Delhi.	
2.	Srinath, L.S., "PERT and CPM Principals and applications" Affiliated East-West Press Pvt. Ltd., New Delhi.	
3.	Patil, B.S., "Civil Engineering Contracts and Estimates" University Press India, Pvt. Ltd. Hyderabad – 500 004	
Reference Books:		
1.	Construction Management by Ojha	
2.	Srivastava, U.K.,"Construction Planning and Management", Galgotia Publications Pvt. Ltd., New Delhi.	
3.	Construction Technology By Sarkar, Oxford.	

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

B.Tech Civil Engineering (Year: IV / Semester: VIII)		
SDCE-482	**Open Channel flow**	**L4 T1 0P C4**
Course Objectives:	The objectives of studying this course are,	
1.	To understand the basic concept of surface flow.	
2.	To understand the energy relationship of flow	
3.	To learn about the different kinds of flow profiles.	
4.	To know the different types of flow measuring devices.	
5.	To understand the designing of culvert.	
Detailed Syllabus		
Unit-I	Introduction: Basic concepts of free surface flows, velocity and pressure distribution, Mass, energy and momentum principle for prismatic and non-prismatic channels, Review of Uniform flow: Standard equations, hydraulically efficient channel sections, compound sections, Energy-depth relations: Concept of specific energy, specific force, critical flow, critical depth, hydraulic exponents, and channel transitions.	**8L**
Unit-II	Gradually Varied Flow (GVF): Equation of gradually varied flow and its limitations, flow classification and surface profiles, Control sections, Computation methods and analysis: Integration of varied flow equation by analytical, graphical and advanced numerical methods, Transitions of subcritical and supercritical flow, flow in curved channels.	**8L**
Unit-III	Rapidly Varied Flow (RVF): Characteristics of rapidly varied flow, Classical hydraulic jump, Evaluation of the jump elements in rectangular and non-rectangular channels on horizontal and sloping beds, Hydraulic jump in gradually and suddenly expanding channels, submerged hydraulic jump, rolling and sky jump, use of jump as an energy dissipater, Flow measurement: by sharp crested and broad crested weirs, critical depth flumes, sluice gate, and Free overfall. Rapidly varied unsteady flow: Equation of motion for unsteady flow, "Celerity" of the gravity wave, deep and shallow water waves, open channel positive and negative surge,	**8L**
Unit-IV	Spatially Varied Flow (SVF): Basic principles, Differential SVF equations for increasing and decreasing discharge, Classifications and solutions, Numerical methods for profile computation, Flow over side-weir and Bottom-rack.	**8L**
Unit-V	**Flow in channel of non-linear alignment and non-prismatic channel sections**: Design considerations for sub critical and super critical flows, Design of culvert.	**8L**
Course Outcomes:		**Level**
CO-1	To learn about the concepts of surface flow.	**K1**
CO-2	To understand the solution of flow problems through the appropriate equations.	**K2**

CO-3	Student has ability to explain the phenomena of hydraulic jump like surge and GVF.	**K3**
CO-4	Apply mathematical relationships and solve the problems related to the notches, hydraulic jumps, and surges.	**K4**
CO-5	Check about the various types of the flow channels.	**K5**
Text Books:		
1.	Chow, V.T., Open channel Hydraulics, McGraw Hill International	
2.	Henderson, F.M., Open Channel Flow, McGraw Hill International	
3.	Subramanya, K., Flow in Open Channels, Tata McGraw Hill	
Reference Books:		
1.	Ranga Raju, K.G., Flow through open channels, T.M.H.	
2.	M. Hanif Chaudhry, Open Channel Flow, PHI	
3.	French, R.H., Open channel Hydraulics, McGraw Hill International	

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

B.Tech Civil Engineering (Year: IV / Semester: VIII)		
SDCE-483	**Pre-stressed concrete structures**	**L4 T1 0P C4**
Course Objectives:	The objectives of studying this course are,	
1.	To analysis the basic concepts of prestressing so that student understands the same	
2.	To find out the various prestressed losses.	
3.	To evaluate the prestressed components strength based on Indian code provisions	
4.	To design the prestressed sections	
5.	To check productivity analysis, Economics of form work.	
Detailed Syllabus		
Unit-I	**INTRODUCTION AND ANALYSIS FOR STRESS** Basic concepts - terminology - system of prestressing, pretensioning, post tensioning, principle of prestressing, types of prestressing. Assumptions, analysis of prestress, concentric & eccentric tendon, resultant stresses, rectangle, I-section(symmetrical only), concepts of prestressing, stress concept, strength concept and load balancing concept.	**8L**
Unit-II	**LOSSES OF PRESTRESS AND ANCHORAGE ZONE STRESSES** Losses of prestress, types, losses due to elastic deformation of concrete, shrinkage of concrete, creep of concrete, friction, anchorage slip. Anchorage zone stresses, stress distribution in end block, investigations on anchorage zone stresses, Indian code provision only.	**8L**
Unit-III	**SHEAR STRENGTH** Behavior of prestressed concrete members under shear, Shear strength, principalstresses, Ultimate shear resistance, and Indian Standard code provision.	**8L**
Unit-IV	Design of sections for flexure, stress condition, minimum section modulus, stresses at transfer, service loads, prestressing force, eccentricity, check for stresses, initial and final conditions, limit state of collapse in flexure, shear. (Rectangular Section only)	**8L**
Unit-V	Use of equipment's in precast prefabricated structure, Productivity analysis, Economics of form work, Design of Formwork and their reusability,	**8L**
Course Outcomes:		**Level**
CO-1	To learn about the basics terminology of the prestressed.	**K1**
CO-2	To understand the losses of the prestressed.	**K2**
CO-3	To check the shear strength and ultimate shear strength of the prestressed concrete.	**K3**
CO-4	To design the sections for flexure, stress condition, minimum section modulus.	**K4**
CO-5	To check and analyze the Productivity analysis and Economics of form.	**K5**
Text Books:		

1.	Krishnaraju R, "Prestressed Concrete", Tata McGraw-Hill Education, New Delhi, 2006.
2.	Pandit .G.S, Gupta .S.P, "Prestressed Concrete", CBS Publishers & Distributors, 2008.
3.	"IS Code Of Practice For Prestressed Concrete", BIS, New Delhi, 1980.
Reference Books:	
1.	Lin T.Y, Design of, "Prestressed Concrete Structures", Asia Publishing House, Bombay 1995
2.	Guyon .V, "Limit State Design of Prestressed Concrete", Vol.I & II Applied Science Publishers, London, 1992.
3.	IS: 1343- 1980,

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IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

B.Tech Civil Engineering (Year: IV / Semester: VIII)		
SDCE-484	**River engineering**	**L4 T1 0P C4**
Course Objectives:	The objectives of studying this course are,	
1.	The goals of this course are to bolster the potential of the Trainees inside the area of water sciences, to create a platform between professionals from one-of-a-kind countries, to change information and enjoy and to increase the expertise of natural river techniques.	
2.	Make observations of and inspect hypotheses approximately river approaches and the effects of river engineering alternatives.	
3.	To apprehend the conduct of alluvial rivers, morphological processes, sediment movement.	
4.	To assess channel instability.	
5.	To investigate flood control strategies	
Detailed Syllabus		
Unit-I	Introduction, classification of Rivers, Mechanics of alluvial rivers including channel and flood plain features, Sediment transport and budgets, River morphology and various classification schemes. 8	**8L**
Unit-II	Behavior of Rivers: Introduction, River Channel patterns, Straight river hannels, causes, characteristics and shapes of meanders and control, cutoff, Braided Rivers, Bed forms, Instability of rivers, Hydraulic geometry, Delta formation and control.	**8L**
Unit-III	Mechanics of Alluvial Rivers, Rivers and restoration structures, Socio-cultural influences and ethics of stream restoration.	**8L**
Unit-IV	Bio-engineering Techniques, Classification review, Natural Channel Design Analysis, Time Series, and Analysis of flow, Sediment and channel geometry data.	**8L**
Unit-V	River Training and Protection Works: Introduction, Classification of River Training, Types of training works, Protection for Bridges with reduced waterway, Design of Guide Band, embankment and spurs/dampers and other river/ flood protection works.	**8L**
Course Outcomes:		**Level**
CO-1	To understand the well knowledge about river engineering.	**K1**
CO-2	To explain the knowledge about canal parts.	**K2**
CO-3	To know about Distribution of structures for canal irrigation and the fundamentals of layout of unlined and coated irrigation canals layout.	**K3**
CO-4	To assess specific flood management techniques.	**K4**
CO-5	To know about basic components of river Training works.	**K5**
Text Books:		

1.	River Behaviour Management and Training (Vol. I & II), CBI&P, New Delhi.
2.	Irrigation & Water Power Engineering- B. C. Punmia and Pande B. B. Lal.
3.	River Engineering by Margeret Peterson
Reference Books:	
1.	Principles of River Engineering by (the non tidel alluvial) PH Jameen
2.	River Engineering by Santosh Kumar
3.	River and Coastal Engineering: Hydraulics, Water Resources and Coastal Engineering (Water Science and Technology Library Book 117) **By Ramakar Jha, Vijay P. Singh, et al.**

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

B.Tech Civil Engineering (Year: IV / Semester: VIII)		
SEOE-481	**Quality Management**	**L4 T1 0P C4**
Course Objectives:	The objectives of studying this course are,	
1.	To study the concepts of quality & TQM.	
2.	To learn the principles & Philosophy of quality management.	
3.	To acquire the basic knowledge of control charts.	
4.	To study the importance of control tools.	
5.	To learn about the ISO and benchmarking system used in quality management.	
Detailed Syllabus		
Unit-I	**Introduction** Quality – Basic Concepts: Issues in Quality, factors affecting quality, Creating quality by design, product development cycle, economics of quality, Various definitions, ISO definition of quality and its meanings, and various phases till TQM and its meaning to industries, customers and employees, contribution of quality gurus etc. towards quality concepts.	**8L**
Unit-II	**Principles & Philosophies of Quality Management** Overview of the contributions of Deming, Juran Crosby, Masaaki Imai, Feigenbaum, Ishikawa, Taguchi techniques – introduction, loss function, parameter and tolerance design, signal to noise ratio. Concepts of Quality circle, Japanese 5S principles and 8D methodology.	**8L**
Unit-III	**Quality Control Charts** Basic statistical concepts, various types of distributions, General theory X and R chart. Decision preparatory to the control charts. Trial control limits. Selection of sub-groups, Charts with variable subgroups. Reject and Revoke, limits for average on X charts, modified control limits, specification limits, practical limitations.	**8L**
Unit-IV	**Quality Control Tools** Check sheet, Histogram, Shapes of Histogram, Drawing a Histogram, Pareto chart, Drawing a pareto chart, Cause & Effect Diagram, Scatter diagram, Acceptable Sampling, Sampling methods, Six Sigma.	**8L**
Unit-V	**Quality Systems Organizing and Benchmarking** Introduction to IS/ISO 9004:2000 – quality management systems – guidelines for performance improvements. Quality Audits. TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward, Definition of benchmarking, reasons of benchmarking, types of benchmarking, Advantage of benchmarking.	**8L**
Course Outcomes:		**Level**
CO-1	Understand the concepts of quality & TQM.	**K1**
CO-2	Study and understand the principles & Philosophy of quality management.	**K2**

CO-3	Acquire the basic knowledge of control charts & their applications.	**K3**
CO-4	Study and apply the quality control tools used in quality management.	**K4**
CO-5	Learn about the ISO and benchmarking system used in quality management.	**K5**
Text Books:		
1.	Quality Control and Reliability, Mahajan, Dhanpat Rai.	
2.	Total Quality Management, Dale H. Besterfield, Pearson Education.	
3.	Total Quality Management –Text and Cases, Shridhara Bhat K, Himalaya Publishing House, First Edition 2002.	
Reference Books:		
1.	Total Quality Management, Dale H. Besterfield, Third edition, Pearson Education.	
2.	Statistical Quality Control, Grant and Leaven, McGraw-Hill.	
3.	Total Quality Management by P.N. Mukherjee, PHI	

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

B.Tech Civil Engineering (Year: IV / Semester: VIII)		
SEOE-482	**Nature inspired engineering**	**L4 T1 0P C4**
Course Objectives:	The objectives of studying this course are,	
1.	To learn about the Nature Inspired Engineering**.**	
2.	To know get the knowledge about Broad Classification of Nature Inspiration.	
3.	To learn about Case Studies of Box Fish & Bionic Car, Birds & Flights.	
4.	To understand the Study of Locomotion pattern of different species.	
5.	To know the Sensory behavior in plants.	
Detailed Syllabus		
Unit-I	**Introduction to Nature Inspired Engineering** Nature Inspired Engineering Terms: Bio inspiration, Bio mimicry, Biomimetic, Nature inspiration & Nature Mimicry. ISO 18458:2015(E). Multifunctional & Multiscale mimetic (bottom up approach) such as self-cleaning building.	**8L**
Unit-II	**Broad Classification of Nature Inspiration:** Nature Inspired Processes, Nature Inspired Methods, Nature Inspired Materials. Gains: Electrical gain, Biological Gain, Chemical Gain, Mechanical Gain & Sustainability Gain	**8L**
Unit-III	**Case Studies:**Box Fish & Bionic Car, Whale wind turbines, Birds & Flights, Lotus Inspired Hydrophobia, Kingfisher & Shinkansen Train, Butterfly & Solar Power	**8L**
Unit-IV	**Study of Locomotion pattern of different species:** Spider, Snakes, Gecko, Primate, Snail, Ants, Swarms.	**8L**
Unit-V	**Sensory behavior in plants:** Plant perception: Aspects of perception: Gravity, Light, Touch, Smell. Self-Regulating Plant Robots: Sunflower, Osmotic Actuation- Chui Mui (Touch me not),	**8L**
Course Outcomes:		**Level**
CO-1	To understand the Nature Mimicry and bio mimicry.	**K1**
CO-2	To demonstrate the Nature Inspired Processes.	**K2**
CO-3	Interpret the Case Studies of Box Fish & Bionic Car.	**K3**
CO-4	To differentiate between Study of Locomotion pattern of different species.	**K4**
CO-5	To justify the Sensory behavior in plants.	**K5**
Text Books:		
1.	Katiyar, N.K., Goel, G., Hawi, S. et al. Nature-inspired materials: Emerging trends and prospects. NPG Asia Mater 13, 56 (2021). https://doi.org/10.1038/s41427-021-00322-y	
2.	Nature-inspired Process Model for concept Selection and Evaluation in Engineering Design: Proceedings of NordDesign 2012, the 9th NordDesign conference, Aarlborg University, Denmark. 22-24.08.2012	
3.	https://www.sciencefocus.com/future-technology/biomimetic-design-10-examples-of-nature-inspiringtechnology/	
Reference Books:		

1.	Tan Ning, Sun Zhenglong, Mohan Rajesh Elara, Brahmananthan Nishann, Venkataraman Srinivasan, Sosa Ricardo, Wood Kristin. A System-of-Systems Bio-Inspired Design Process: Conceptual Design and Physical Prototype of a Reconfigurable Robot Capable of Multi-Modal Locomotion, Frontiers in Neurorobotics, VOLUME 13, 2019. https://www.frontiersin.org/article/10.3389/fnbot.2019.00078N=1662-5218	
2.	https://en.wikipedia.org/wiki/Plant_perception_(physiology)	

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VIII

B.Tech Civil Engineering (Year: IV / Semester: VIII)		
SEOE-483	**Non-Conventional Energy Resources**	**L4 T1 0P C4**
Course Objectives:	The objectives of studying this course are,	
1.	To provide a survey of the most important renewable energy resources and the technologies for harnessing these resources within the framework of a broad range of simple to state- of -the-art energy systems.	
2.	To understand the utilization of solar thermal energy.	
3.	To understand the principles of MHD.	
4.	To analyze the utilization of wind energy.	
5.	To generate the biomass and ocean energy.	
Detailed Syllabus		
Unit-I	**Introduction-** Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits. Solar Cells: Theory of solar cells. Solar cell materials, solar cell array, solar cell power plant, limitations.	**8L**
Unit-II	**Solar Thermal Energy:** Solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.	**8L**
Unit-III	**Energy:** Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations. **Magneto-hydrodynamics (MHD):** Principle of working of MHD Power plant, performance and limitations. **Fuel Cells:** Principle of working of various types of fuel cells and their working, performance and limitations.	**8L**
Unit-IV	**Thermo-electrical and thermionic Conversions:** Principle of working, performance and limitations. **Wind Energy:** Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. Performance and limitations of energy conversion systems.	**8L**
Unit-V	**Bio-mass:** Availability of bio-mass and its conversion theory. **Ocean Thermal Energy Conversion (OTEC):** Availability, theory and working principle, performance and limitations. **Wave and Tidal Wave:** Principle of working, performance and limitations. Waste Recycling Plants.	**8L**
Course Outcomes:	Demonstrate the production of power using various non-conventional energy sources.	**Level**
CO-1	Understand the concepts involved in solar energy collection and its conversion into electricity.	**K1**

CO-2	Acquainted with the working knowledge of various types of fuel cells, and principles of geothermal energy.	**K2**
CO-3	Studying the performance of a wind energy conversion system can help you explore the ideas involved.	**K3**
CO-4	To illustrate the ocean energy and explain the operational methods of their utilization.	**K4**
CO-5	Demonstrate the production of power using various non-conventional energy sources.	**K5**
Text Books:		
1.	Raja etal, "Introduction to Non-Conventional Energy Resources" Scitech Publications	
2.	John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.	
3.	M.V.R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional" BSP Publications,2006.	
Reference Books:		
1.	D.S. Chauhan,"Non-conventional Energy Resources" New Age International	
2.	C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.	
3.	Peter Auer, "Advances in Energy System and Technology". Vol. 1 & II Edited by Academic Press.	

Format-3

IIMTU-NEP IMPLEMENTATION
Year: IV / Semester: VII

B.Tech Civil Engineering (Year: IV / Semester: VIII)		
SEOE-484	**Product Development and development**	**L4 T1 0P C4**
Course Objectives:	The objectives of studying this course are,	
1.	Competence with a set of tools and methods for product design and development.	
2.	Confidence in your own abilities to create a new product.	
3.	Awareness of the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, engineering, production).	
4.	Ability to coordinate multiple, interdisciplinary tasks in order to achieve a common objective.	
5.	Reinforcement of specific knowledge from other courses through practice and reflection in an action-oriented setting.	
Detailed Syllabus		
Unit-I	Concept of Product, definition and scope. Design definitions, old and new design methods, design by evolution, examples such as evolution of sewing M/C, bicycle, safety razor etc., need based developments, technology-based development's physical reliability & economic feasibility of design concepts.	**7L**
Unit-II	Morphology of design, divergent, transformation and convergent phases of product design, identification of need, Analysis of need. Design criteria; functional, aesthetics, ergonomics, form, shape, size, colour. Mental blocks, Removal blocs, Ideation techniques, Creativity, Check list.	**9L**
Unit-III	Transformations, Brainstorming & Synetics, Morphological techniques. Utility Concept, Utility Value, Utility Index, Decision making under Multiple Criteria. Economic aspects, Fixed and variable costs, Break-even analysis.	**9L**
Unit-IV	Reliability considerations, Bath tub curve, Reliability of systems in series and parallel, Failure rate, MTTF and MTBF, Optimum spares from Reliability considerations. Design of display and controls, Man- machine interface, Compatibility of displays and controls. Ergonomic aspects, Anthropometric data and its importance in design. Application of Computers in Product development & design.	**10L**
Unit-V	Existing techniques, such as work-study, SQC etc. for improving method & quality of product. Innovation versus Invention. Technological Forecasting. Use of Standards for Design.	**8L**
Course Outcomes:		**Level**
CO-1	Learn the product design and development systems, old and new design methods, physical reliability & economic feasibility of design concepts.	**K1**
CO-2	Understand morphology of design, divergent, transformation and convergent phases of product design	**K2**

CO-3	The student can identify different areas of Product Development & Value Engineering.	**K3**
CO-4	Understand the application of reliability in various operations & can find the applications of all the areas in day-to-day life.	**K2**
CO-5	Understand the concepts of existing techniques, such as work-study, SQC etc. and use of standards for design.	**K2,K5**
Text Books:		
1.	A.K. Chitab & R.C. Gupta "Product design & Manufacturing" – Prentice Hall (EE)	
2.	R.P. Crewford, "The Technology of creation Thinking" Prentice Hall.	
3.	C.D. Cain, "Product Design & Decision" Business Books.	
Reference Books:		
1.	C.D. Cain, "Product Design & Decision" Business Books.	
2.	Allen C. Ward. "Lean Product and Process Development"	
3.	The Art of Thought-Grohem Walls-Bruce & Co., New York.	

Evaluation Scheme

Biotechnology

Evaluation Scheme – Bachelor of Technology (Biotechnology)
Year: I / Semester: I

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	ENMS-111/ ENBS-111	Foundational Math Skills-I/ Foundational Biology Skills-I	Th	Core-1	3	1	0	4	30	20	50	100	150
2.	ENAS-112	Modern Physics in Engineering	Th	Core -2	3	1	0	4	30	20	50	100	150
	ENAS-113	Engineering Chemistry											
3.	ENBT-111	Introduction to Biotechnology	Th	Core -3	3	1	0	4	30	20	50	100	150
4.	ENCS-111	Structured Programming and Problem Solving in C	Th	VAC-1	3	1	0	4	30	20	50	100	150
5.	ENAS-114	Professional Communication and Digital fluency	Th	AECC-1	3	1	0	4	30	20	50	100	150
	ENHU -112	Environment, Ecology and Sustainability		AECC-2									
6.	ENAS-112P	Modern Physics in Engineering Lab	P	LAB-1	0	0	2	1	0	15	15	35	50
	ENAS-113P	Engineering Chemistry Lab											
7.	ENCS-111P	Programming With C Lab: Hands on Logic Building	P	LAB-2	0	0	2	1	0	15	15	35	50
8.	ENAS-114P	Professional Communication and Digital fluency Lab	P	LAB-3	0	0	2	1	0	15	15	35	50
	ENHU -112P	Environment, Ecology and Sustainability Lab											
9.	ENBT-113P	Biotechnology Lab	P	LAB-4	0	0	2	2	0	15	15	35	50
10.	ENME-111P	Rapid Prototyping Lab	P	LAB-5	0	0	2	2	0	15	15	35	50
11.	ENPH-111	Spiritual And Cultural Heritage: Indian Experience	P	AC	0	0	0	NC*	0	25*	25*	0	25*
12.	NECC -112*	University Social Responsibility - Community Outreach	P	AC	0	0	0	NC*	0	25*	25*	0	25*
13.	SPNC-111*	Sports	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**15**	**5**	**10**	**27**	**150**	**175**	**325**	**675**	**1000**

TH- Theory paper, P-Practical, L-Lecture, T-Tutorials, C-Credit, AECC – Ability Enhancement Compulsory Course, AC – Audit Courses, NC*-No Credit Course, CT – Class Test (Sessional Examinations), TA – Teacher's Assessment, ESE – End Semester Examinations.
University Social Responsibility& Sports - Community Outreach and Sports, Spiritual And Cultural Heritage: Indian Experience are Non-Credit Qualifying Courses. Their marks will not be added in final marks.

Note: NCC is offered as General Elective.

Evaluation Scheme – Bachelor of Technology (Biotechnology)
Year: I / Semester: II

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	ENMS-121/ ENBS-121	Foundational Math Skills-II/ Foundational Biology Skills-II	Th	Core-4	3	1	0	4	30	20	50	100	150
2.	ENAS-123	Engineering Chemistry	Th	Core-5	3	1	0	4	30	20	50	100	150
	ENAS-122	Modern Physics in Engineering											
3.	ENEE-121	Electrical & Electronics in the Modern World	Th	Core-6	3	1	0	4	30	20	50	100	150
4.	ENCS-121	Fundamental Concepts and Problem Solving with Python	Th	VAC-2	3	1	0	4	30	20	50	100	150
5.	ENAS-124	Professional Communication and Digital fluency	Th	AECC-2	3	1	0	4	30	20	50	100	150
	ENHU -122	Environment, Ecology and Sustainability		AECC-1									
6.	ENAS-123P	Engineering Chemistry Lab	P	LAB-6	0	0	2	1	0	15	15	35	50
	ENAS-122P	Modern Physics In Engineering Lab											
7.	ENCS-121P	Fundamental Concepts and Problem Solving with Python Lab	P	LAB-7	0	0	2	1	0	15	15	35	50
8.	ENAS-124P	Professional Communication Lab	P	LAB-8	0	0	2	1	0	15	15	35	50
	ENHU-122P	Environment, Ecology and Sustainability Lab											
9.	ENEE-121P	Electrical & Electronics in the Modern World Lab	P	SEC-1	0	0	2	1	0	15	15	35	50
10.	ENBS-121P	Foundational Biology Lab	P	SEC-2	0	0	2	2	0	15	15	35	50
11.	ENHW-121	Health and Wellness	P	AC	0	0	0	NC*	0	25*	25*	0	25*
12.	NECC-121*	Industrial Visit / Seminar on the report of visit	P	AC	0	0	0	NC*	0	25*	25*	0	25*
13.	NECC -122*	University Social Responsibility - Community Outreach	P	AC	0	0	0	NC*	0	25*	25*	0	25*
14.	SPWC-121	Sports	P	LAB-10	0	0	2	1	0	0	0	25	25
Total					**15**	**5**	**12**	**27**	**150**	**175**	**325**	**700**	**1025**

TH- Theory paper, P-Practical, L-Lecture, T-Tutorials, C-Credit, AECC – Ability Enhancement Compulsory Course, AC – Audit Courses, NC*-No Credit Course, CT – Class Test (Sessional Examinations), TA – Teacher's Assessment, ESE – End Semester Examinations. University Social Responsibility - Community Outreach and Sports, Industrial Visit, Health and Wellness are Non-Credit Qualifying Courses. Their marks will not be added in final marks.
Note: NCC is offered as General Elective.

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CBCS: Statement of Credit distribution (w.e.f: Session 2024-25)

College/School: School of Engineering & Technology **Programme: B.Tech** **Duration: 8 Semester Annual/Semester: Semester**	**Credit range: 160-190** **(Suggested by** **CBCS Committee)**

COURSE	CREDIT	SEMESTER	CORE COURSE Major	DSE Minor	AECC	SEC	GE (Th 4) Interdisciplinary	General Elective	Value Added Course (VAC)	Industrial Training/ Survey / Research Project	Total Credits
No Exit Allowed	26	I	C-1 (4 Credit) C-2 (4 Credit)+P-01(1Credit) C-3 (4 Credit)+P-02(1Credit)		AECC-1 (4Credit)+ P-04 (1Credit)	SEC-1 P-(2 Credit)		NCC	VAC-1 (4 Credit) + P-9(1Credit)		26
	28	II	C-4 (4 Credit) C-5 (4 Credit)+P-05(1Credit) C-6 (4 Credit)+P-06(2Credit) P-8 (1 Credit)		AECC-2 (4Credit)+ P-04 (1Credit)	SEC-2 P-(2 Credit)		NCC	VAC-2 (4 Credit) + P-9(1Credit)		28
Certificate in Engineering	26	III	C-07(4 Credit) C-8 (4 Credit)+P-10(2 Credit) C-9 (4 Credit)+P-11(2 Credit) C-10 (4Credit)+P-12(2 Credit)		AECC-3 (P- 2Credit)	SEC-3 (2 Credit)		NCC			26
	28	IV	C-11(4 Credit) C-12 (4 Credit)+P-13(2 Credit) C-13 (4 Credit)+P-14(2 Credit)	DSE-1 (4 Credit)			GE-1 (4 Credit)	NCC	VAC-3 (2 Credit)		28

			P-15(2 Credit)								
Diploma in Engineering	26	V	C-14 (4 Credit)+P-16(2 Credit) C-15 (4 Credit)+P-17(2 Credit) C-16 (4 Credit)+P-18(2 Credit)	DSE-2 (4 Credit)		SEC-4 (2 Credit)		NCC		INT-1 (2 Credit) RP-I (NC*)	26
	20	VI	C-17 (4 Credit)+P-19(2 Credit) C-18 (4 Credit)+P-20(2 Credit)	DSE-3 (4 Credit)	AECC-4 (2 Credit)	SEC-5 (2 Credit)		NCC		RP-II(NC*)	20
B.Tech (Degree)	18	VII	C-19 (4 Credit)+P-21(2 Credit)			SEC-6 (2 Credit)	GE-2 (4 Credit)	NCC		INT-2 (2 Credit) Minor Project (4 Credit)	18
	18	VIII		DSE-4 (4 Credit)			GE-3 (4 Credit)	NCC		Major Project (10 Credit)	18
			19(Th)*4(C) = 76 04(Pr)*01(C) = 04 13(Pr)*2(C) = 26 **Total = 106**	4(Th)*4(C) =16 **Total =16**	02(Th)*04(C)=8 02(Pr)*01(C)=02 01(Pr)*02(C)=02 01(Th)*02(C)=02 **Total =14**	02(Pr)*02(C)=4 04(Th)*02(C)=8 **Total =12**	03(Th)*04(C)=12 **Total =12**		02(Th)*04(C)=8 02(Pr)*01(C)=02 01(Th)*02(C) =02 **Total =12**	2+2+4+10=18 **Total =18**	**190**

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IMTU-NEP Implementation: (w.e.f. Session 2025-26) **(B.Tech. Biotechnology)**

Program	Year	Semester (15) weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester	Prerequisite	Elective (For other faculty)
BACHELOR OF TECHNOLOGY – BIOTECHNOLOGY	FIRST YEAR	SEMESTER -I	i) Core-1 (Th.4C)	4	5	45	Foundational Math Skills-I/ Foundational Biology Skills-I	5		
			ii) AECC-1 (Th.4 C+ P 1 C)	4 1	4 3	45 30	Effective Engineering Communication / Environment and Ecology Effective Engineering Communication Lab / Environment and Ecology Lab	5		
			iii) Core-2 (Th.4 C + P 1 C)	4 1	5 3	45 30	Engineering Physics / Engineering Chemistry Engineering Physics Lab / Engineering Chemistry Lab	5		
			iv) Core-3 (Th.4 C)	4	5	45	Introduction to Electrical and Electronics Engineering / Introduction to Biotechnology	5		
			v) VAC-1 (Th.4 C + P 1 C)	4 1	5 3	45 30	Structured Programming and Problem Solving in C Structured Programming and Problem Solving in C lab	5		
			vi) SEC-1(P 2C)/ LAB-4	2	3	30	Biotechnology Lab / Introduction to Electrical and Electronics Engineering Lab			
			vii) LAB-5 (P 1 C)	1	3	30	Mechanical Workshop Lab / Engineering Graphics & Design Lab			
			viii) Audit Course	NC	-	-	University Social Responsibility - Community Outreach			
			ix) Audit Course	NC	-	-	Sports			

Program	Year	Semester (15) weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester	Prerequisite	Elective (For other faculty)
		SEMESTER - II	i) Core-4 (Th4C)	4	5	45	Foundational Math Skills-II/ Foundational Biology Skills-II	5		
			ii) AECC-2 (Th4 C+ P 1 C)	4 1	4 3	45 30	Environment and Ecology / Effective Engineering Communication Environment and Ecology Lab / Effective Engineering Communication Lab	5		
			iii) Core-5 (Th4 C + P 1 C)	4 1	5 3	45 30	Engineering Chemistry/ Engineering Physics Engineering Chemistry Lab/ Engineering Physics Lab	5		
			iv) Core-6 (Th4 C)	4	5	45	Introduction to Electrical and Electronics Engineering / Introduction to Biotechnology	5		
			v) VAC-2 (Th4 C + P 1 C)	4 1	5 3	45 30	Fundamental Concepts and Problem Solving with Python Fundamental Concepts and Problem Solving with Python Lab	5		
			vi) SEC-1(P 2C)/ Lab-9	2	3	30	Biotechnology Lab / Introduction to Electrical and Electronics Engineering Lab	-		
			vii) Lab-10 (P 1 C)	1	3	30	Mechanical Workshop Lab / Engineering Graphics & Design Lab	-		
			viii) SEC-2 (P 2 C)	2	3	30	Foundational Biology Lab	-		
			ix) Audit Course	NC	-	-	Industrial Visit /Seminar on the report of visit	-		
			x) Audit Course	NC	-	-	University Social Responsibility - Community Outreach	-		
			xi)Lab 10 (SPT-PC-111)	2	3	30	Sports	5		
Program Outcome: PO1 - PO12 [ANNEXTURE-1]							**Program Specific Outcome:** PSO1 – PSO2 [ANNEXTURE-2]			
Note: 1. A total of 8 Credits are mandatory to earn from NPTEL/Moocs/Coursera during 4 years of B.Tech Program.										

ANNEXTURE-1

Program Outcomes:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and
Research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

ANNEXTURE-2

Program Specific Outcomes:

PSO1: Enabling students to learn continuously and to provide effective answers to new computational issues.

PSO2: Understand analyze data and create software to create computer-based systems of varying complexity that are designed effectively.

Format-3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG (R) **Class: B.Tech. Biotechnology**			**Year: I** **Semester: I**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENMS-111**
4	**NA**	**Course Name**	**Foundational Math Skills-I**

Course Objectives:

1. The effective mathematical tools of Algebra to solve the quadratic Equation.
2. The tools of concepts of sequence and Series are introduced.
3. To apply concepts of Trigonometric in engineering mathematics.
4. The elementary concept of calculus using limits and derivatives.
5. To deal with continuous and differentiable functions to identify the rate of change and its.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of Total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit (4 Hrs./Week = 4 Credits)

Units	Contents	No. of Lectures Allotted
I	**Unit-1: Algebra** Fundamental Theorem of Algebra, Definition and Standard form of quadratic equation, Solution of quadratic equation (factorization and quadratic formula method). System of linear equations in two variables (Algebraic and Graphical methods).	**9L**
II	**Unit-2: Arithmetic and Geometric Progressions** Arithmetic progression (A.P.), general term of A.P., sum of a series in A.P., arithmetic mean (A.M.) Geometric progression (G.P.), general term of a G.P., sum of n terms of a G.P., sum of infinite terms in G.P., geometric mean (G.M.), relation between A.M. and G.M.	**9L**
III	**Unit-3 Trigonometric Functions** Angles and Their Measurement, Trigonometric Ratios, Trigonometric ratios of some specific angles, Trigonometric Identities, Application of Trigonometry: Heights & Distances (Basic Problems).	**9L**
IV	**Unit-4: Differential Calculus I** Introduction, Definition of limit, continuity and differentiability, derivative of sum, difference, product and quotient of functions. Derivatives of polynomial and trigonometric function, derivative of composite functions, chain rule, derivatives of inverse trigonometric functions, exponential, logarithmic and parametric forms. Logarithmic differentiation.	**9L**
V	**Unit-5: Differential Calculus II** Applications of Derivatives: Rate of change, Errors & Approximations, Maxima and Minima of functions of one variable.	**9L**

Text Books/ Reference Books:

1. NCERT Mathematics Textbooks (Class IX & X), NCERT, New Delhi.
2. R.S. Aggarwal, Secondary School Mathematics, Bharti Bhawan Publishers.
3. 3. R.D. Sharma, Mathematics for Class IX & X, Dhanpat Rai Publications.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	Apply algebraic principles to solve quadratic equations and systems of linear equations using both algebraic and graphical methods.	**L2 & L3**
CO-2	Demonstrate understanding of sequences and series, including Arithmetic Progression (A.P.) and Geometric Progression (G.P.), and compute their general terms, sums, means, and relationships.	**L3 &L4**
CO-3	Understand and use trigonometric functions and identities to solve basic problems involving angles, ratios, and applications such as heights and distances.	**L1& L3**
CO-4	Understand and compute limits, continuity, and derivatives of various types of functions, including polynomial, trigonometric, inverse trigonometric, exponential, and logarithmic functions using standard rules.	**L2 & L3**
CO-5	Apply derivatives in real-world contexts, including rates of change, approximations, and finding maxima and minima of single-variable functions.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Engineering Mathematics-I(RTAS-111)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	3	2	1	0	0	0	0	1	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	2	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG (R) **Class: B.Tech. Biotechnology**			**Year: I** **Semester: I**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENBS-111**
4	**NA**	**Course Name**	**Foundational Biology Skills-I**

Course Objectives:
1. To introduce the basic principles and organization of life at cellular and molecular levels.
2. To familiarize students with biological classification and diversity among life forms.
3. To build an understanding of structure and function in plants and animals.
4. To provide basic insights into biomolecules and cell biology.
5. To enable students to relate biology concepts to biotechnology applications.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of Total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit (4 Hrs./Week = 4 Credits)

Units	Contents	No. of Lectures Allotted
I	**Introduction to Life and Diversity of Life Forms-** • Characteristics of living organisms. • Classification of living organisms (Five kingdom classification). • Basic idea of prokaryotes and eukaryotes. • Concept of species, genus, and taxonomy. • Introduction to viruses and viroids.	**9L**
II	**Cell – The Basic Unit of Life-** • Cell theory and types of cells. • Structure of prokaryotic and eukaryotic cells. • Cell organelles: nucleus, mitochondria, chloroplast, ER, Golgi body, lysosome, ribosome. • Plasma membrane structure and transport mechanisms.	**9L**
III	**Biomolecules-** • Introduction to biomolecules. • Carbohydrates: types and functions. • Proteins: structure and function. • Lipids: types and biological roles. • Nucleic acids (DNA and RNA): structure, basic functions.	**9L**
IV	**Cell Cycle and Cell Division-** • Cell cycle: phases and significance. • Mitosis and meiosis: stages and differences. • Significance of cell division in growth and reproduction.	**9L**

V	**Tools and Techniques in Biology-** • Introduction to microscopy: light and electron microscopes. • Basic staining techniques. • Measurement units: micron, nanometer. • Introduction to model organisms used in biology.	**9L**

Textbooks/References:

1. NCERT Biology Class XI & XII.
2. Solomon, Berg & Martin: *Biology*.
3. G. Rastogi – *Fundamentals of Biology*.
4. Guyton & Hall – *Human Physiology* (selective reading).
5. Campbell – *Biology* (simplified sections).

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	Understand fundamental biological terms, concepts, and cell structures.	**L2 & L3**
CO-2	Identify different organisms based on classification systems.	**L3 &L4**
CO-3	Explain basic life processes such as digestion, respiration, and circulation.	**L1& L3**
CO-4	Recognize the role of biomolecules in life processes.	**L2 & L3**
CO-5	Build a foundational understanding suitable for advanced biotechnology courses.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	3	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	3	2	1	0	0	0	0	2	2
CO-3	2	2	0	1	1	0	0	0	0	0	1	2
CO-4	3	1	1	3	2	1	0	0	0	0	1	1
CO-5	2	2	2	2	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech. Biotechnology**			**Year: I** **Semester: I/ II**
Credits: 5		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENAS-112/ENAS-122**
3	**2**	**Course Name**	**Modern Physics in Engineering**

Course Objectives:

1. To know the concept of Interference and Diffraction.
2. To know the significance of Maxwell's equations in the Engineering applications of electromagnetic waves.
3. Explain Quantum Mechanics to understand wave particle dualism. Necessity of quantum mechanics to explore.
4. To understand the concept of Relativistic Mechanics.
5. To understand the Phenomenon of Fiber optics and Laser.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of Total)
50% Marks / 2 Credits

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit (4 Hrs./Week = 4 Credits)

Units	Contents	No. of Lectures Allotted
I	**Wave Optics:** Interference: Basics of interference of light, coherent Sources, Conditions of Interference; Interference by division of wave front and amplitude (Interference due to thin film, Wedge shaped film and Newton's Rings). **Diffraction:** Fraunh offer Diffraction Due Single slit, Diffraction Grating; Rayleigh's criterion of resolution; absent spectra, dispersive Power of grating, Resolving power of Grating.	**12L**
II	**Electromagnetic:** Gauss law Ampere's law and displacement current; Equation of continuity; Maxwell's equations in Integral and Differential Forms; Electromagnetic Wave Propagation in Free Space and Conducting Media; Poynting Theorem.	**9L**
III	**Quantum Mechanics**: Planck's concept (hypothesis), Compton Effect, Particle properties of wave: Matter Waves, Davisson Germer Experiment, Heisenberg Uncertainty Principle, Wave function, and Schrodinger equation (time dependent & independent), Particle in a 1-D box.	**9L**
IV	**Relativistic Mechanics**: Inertial and Non- Inertial Frames; Michelson-Morley Experiment; Postulates of Special Theory of Relativity; Galilean and Lorentz Transformation; Length Contraction and Time Dilation; Addition of Velocities; Mass Energy Equivalence and Variation of Mass with Velocity.	**9L**
V	**Laser**: Absorption of radiation, Spontaneous and stimulated emission of radiation, Population inversion, Einstein's Coefficients, Principles of laser action, Components of laser, Solid state Laser (Ruby laser) and Gas Laser	**6L**

	(He-Ne laser), Laser applications.	

Text Books:

1. Concepts of Modern Physics – Aurthur Beiser (Mc-Graw Hill)
2. Introduction to Special Theory of Relativity- Robert Resnick (Wiley)
3. Engineering Physics: Theory and Practical- Katiyar and Pandey (Wiley India)

Reference Books:

1. *Applied Physics for Engineers- Neeraj Mehta (PHI Learning, New).*
2. *Engineering Physics-Malik HK and Singh AK (Mc Graw Hill).*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Physics of Class 12

Course Learning Outcomes:

CO-1	Apply the principles of wave optics to analyze and predict light behavior in various scenarios.	**L3 & L4**
CO-2	Analyze and solve problems involving electromagnetic fields and waves in various contexts.	**L4**
CO-3	Remember and apply the principles of quantum mechanics to understand and predict the behavior of particles at the atomic and subatomic levels.	**L1 & L3**
CO-4	Understand the principles of relativistic mechanics to analyze and predict the behavior of objects moving at velocities close to the speed of light.	**L2 & L4**
CO-5	Understand and apply the principles of laser technology.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Engineering Physics-I(RTAS-112/RTAS-122)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B. Tech. Biotechnology**			**Year: I** **Semester: I/II**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENAS-113/ ENAS-123**
4	**NA**	**Course Name**	**Engineering Chemistry**

Course Objectives:

1. To enable the students to understand about the Chemistry of Atomic and Molecular structure, Chemistry of advanced Materials like Liquid crystals, Nanomaterials, Graphite & fullerenes, and Green Chemistry.
2. To enable the students to understand and apply the detailed concepts of spectroscopic techniques and stereochemistry to identify the compounds, element etc.
3. To enable the students to understand and apply the concepts related to Electrochemistry, Batteries, Corrosion and Chemistry of Engineering Materials like cement.
4. To enable the students to understand and apply detailed concepts of water source, water impurities, hardness of water and boiler troubles used in industry as well as analysis of coal & determination of calorific values.
5. To enable the students to understand detailed concepts related to polymers, Polymerization, Polymer Blends, Polymer Composites, and organometallic compounds.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of Total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit(4 Hrs./Week = 4 Credits)

Unit	Contents	No. of Lectures Allotted
I	**Atomic and Molecular Structure:** Molecular orbitals of diatomic molecules (bond order, magnetic characters and numerical problems). **Chemistry of Advanced Materials:** ***Liquid Crystals;*** Introduction, Types and Applications of liquid crystals, industrially important materials used as liquid crystals. ***Graphite and Fullerene;*** Introduction, Structure and applications. ***Nanomaterials;*** Introduction, Preparation, characteristics of nanomaterials and applications of nanomaterials: Carbon Nano Tubes (CNT) and graphene. **Green Chemistry**: Introduction to green chemistry, 12 principles and importance of green Synthesis, Green Chemicals, Synthesis of typical organic compounds by conventional and Green routes (Adipic acid and Paracetamol), Environmental impact of Green chemistry on society.	**10L**
II	**Spectroscopic techniques and Applications:** Elementary idea and simple applications of Ultraviolet (UV) & Visible, fluorescence, Jablonski diagram, IR and Raman spectroscopy. **Stereochemistry**: Optical isomerism in compounds without chiral carbon, Geometrical isomerism, Chiral Drugs.	**8L**

III	**Electrochemistry:** Nernst Equation and application, relation of EMF with thermodynamic functions (ΔH, ΔF and Δ S). Lead storage battery. **Corrosion**; causes, effects and its prevention. **Chemistry of Engineering Materials:** Cement; Constituents, manufacturing, hardening and setting, deterioration of cement, Plaster of Paris (POP).	**9L**
IV	**Water Analysis:** Hardness of water, Techniques for water softening (Lime-soda, Zeolite, Ion exchange resin and Reverse osmosis method). **Fuels:** classification of fuels, Analysis of coal, Determination of calorific value (Bomb calorimeter and Dulon's method).	**8L**
V	**Polymers:** Basic concepts of Polymer-Blend and composites, Conducting and biodegradable polymers. Preparation and application of some industrially important polymers (Buna-S, Buna-N, Neoprene, Nylon-6, nylon-6,6, Teflon, Lucite, Bakelite, and Terylene). **Organometallic Compounds**: General methods of synthesis of organometallic compounds (Grignard reagent and lithium aluminum hydride) and their applications.	**9L**

Reference Books:

1. Engineering Chemistry by Rath & Singh, 2nd Edition, Cengage Learning India Pvt. Ltd Delhi.
2. Engineering Chemistry by SS Dara, S Chand & Co Ltd
3. Engineering Chemistry by Jain & Jain, S. Chand & Comp, New Delhi
4. Engineering Chemistry by K. Sesha Maheswaramma, Pearson
5. Engineering Chemistry by OG Palanna, Mc Graw Hill Education, New Delhi
6. Engineering Chemistry by Shashi Chawala, Dhanpat Rai Publishing Comp, New Delhi

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NA**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: NA

Course Learning Outcomes: After completion of the course, the student should be able to:

CO-1	Understand about the principles of atomic and molecular structure, bonding and properties, chemistry of advanced materials like Liquid Crystals, Nanomaterials, Graphite, graphene & Fullerenes as well as the principles of green chemistry.	**L1 & L2**
CO-2	Apply the fundamental concepts of determination of structure with various spectral techniques and stereochemistry	**L2 & L3**
CO-3	Apply the theory of construction of electrodes, batteries and fuel cells and re-designing or new engineering products, and categorize the reasons for corrosion and study methods to control corrosion, and develop an understanding of the chemistry of cement.	**L3 & L2**
CO-4	Understand the sources, impurities and hardness of water, apply the concepts of determination of calorific values and analyze the coal.	**L2, L3 & L4**

CO-5	Understand the chemical structure of polymers and its effect on their various properties when used as engineering materials. Understanding the applications of specific polymers and organometallic compounds, applicable in industrial process.	**L1 & L2**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Engineering Chemistry (RTAS-113/RTAS-123)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	3	2	2	2	2	0	0	0	0	2
CO-2	2	3	2	3	3	1	1	0	0	0	0	2
CO-3	3	3	3	3	2	2	2	0	1	0	0	1
CO-4	3	3	3	2	2	2	2	0	0	0	0	1
CO-5	3	3	2	2	2	2	2	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG (R) **Class: B.Tech. Biotechnology**			**Year: I** **Semester: I/II**
Credits		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENEE-111/ ENEE-121**
04	**NA**	**Course Name**	**Electrical & ELECTRONICS IN THE MODERN WORLD**

Course Objectives:

1. To explain the laws used in the analysis of DC and AC circuits.
2. To explain the behavior of DC circuits.
3. To explain the Fundamentals of Alternating Current.
4. Provide idea about Semiconductor devices & Rectifier
5. To explain the concept of Transistors.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of Total)

L: 3	**T: 1**	**P: 0**	**C: 4**

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit(4 Hrs./Week = 4 Credits)

Units	**Contents**	**No. of Lectures Allotted**
I	**Basics of Electrical Circuits**: Electrical circuit elements (R, L and C), active and passive elements, voltage and current sources, concept of linearity, unilateral and bilateral elements, AC & Dc power and electrical energy.	9L
II	**DC Circuit**: Introduction to DC circuits, series and parallel combination of resistance, Kirchhoff's laws, Mesh and nodal methods of analysis, DC theorems-Superposition Theorems, Thevinen's Theorem Norton's theorem, Maximum Power Transfer Theorem, Reciprocity Theorem, Star-Delta conversion.	9L
III	**AC Circuit: Representation of Sinusoidal waveforms**–Average and effective values, Form and peak factors. Analysis of single phase AC Circuits consisting of R-L-C combination (Series and Parallel) Apparent, active & reactive power, Power factor. Concept of Resonance in series & parallel circuits, bandwidth and quality factor. Three- phase balanced circuits, voltage and current relations in star and delta connections. Electromagnetism.	9L
IV	**Basics of Electronics**: Overview of electronics, its branches, and applications, Semiconductor Diode: Depletion layer, V-I characteristics, ideal and practical Diodes, Diode Equivalent Circuits, Zener Diodes breakdown mechanism (Zener and avalanche) Diode Application: Diode Configuration. Half and Full Wave rectification, Clippers, Clampers, Voltage-Multiplier Circuits Special Purpose two terminal Devices: Light- Emitting Diodes, Photo Diodes, Varactor Diodes, Tunnel Diodes.	9L
V	**Transistor**: Bipolar Junction Transistor: Transistor Construction, Operation, Amplification action. Common Base Common Emitter, Common Collector Configuration Field Effect Transistor: Construction and Characteristic of JFETs. Transfer Characteristic. MOSFET (MOS) (Depletion and Enhancement) Type,	9L

	Transfer Characteristic.	

Text Books:

1. Robert L. Boylestand / Louis Nashelsky "Electronic Devices and Circuit Theory", Pearson Education.
2. R. Muthusubramanian, S. Salivahanan, "Basic Electrical and Electronics Engineering", Tata McGraw-Hill Education, Reprint 2012
3. George Kennedy, "Electronic Communication Systems", McGraw Publication

Reference Books:

1. David A. Bell, "Electronic Devices and Circuits", Oxford University Press.
2. Jacob Millman, C.C. Halkias, StayabrataJit, "Electronic Devices and Circuits", McGraw Hill
3. David A. Bell, Electronic Instrumentation and Measurements, Latest Edition, Oxford Uni Press India.

If the course is available as Generic Elective, then the students of following departments may opt it:
NO

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Physics of Class 12

Course Learning Outcomes:

CO-1	Understand the basic terminology/definitions of electrical engineering.	L2 & L3
CO-2	Apply the knowledge of theorems/laws to analyze the simple DC circuits.	L3 &L4
CO-3	Construct and analyze simple AC circuits and use the principles of electromagnetic induction in electrical applications.	L1& L3
CO-4	Students will gain knowledge regarding various types' semiconductors and use the knowledge of Rectifiers.	L2 & L3
CO-5	To understand working of Transistors and MOSFET circuits.	L2 & L4

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Introduction to Electrical & Electronics Engineering (RTEE-111/ RTEE-121)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech. Biotechnology**			**Year: I** **Semester: I/II**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENBT-111/ENBT-121**
4	**NA**	**Course Name**	**Introduction to Biotechnology**

Course Objectives:
1. To introduce students to the history, scope, and applications of biotechnology.
2. To make students aware of the interdisciplinary nature of biotechnology.
3. To familiarize them with tools, basic techniques, and fields within biotechnology.
4. To explore emerging trends like bioinformatics, genetic engineering, and synthetic biology.
5. To prepare students for biotechnology careers by showing academic and industry pathways.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of Total)

L: 3	**T: 1**	**P: 0**	**C: 4**

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit (4 Hrs./Week = 4 Credits)

Unit	Contents	No. of Lectures Allotted
I	**Fundamentals and Scope of Biotechnology-** • What is Biotechnology? Definition and concept. • Historical development of biotechnology. • Branches of biotechnology: medical, agricultural, industrial, environmental. • Interdisciplinary nature: connection with biology, chemistry, physics, math, and engineering. • Impact on society, health, food, and environment.	**9L**
II	**Tools, Techniques & Basic Concepts** • Introduction to DNA, genes, and proteins (basic idea). • Genetic engineering and recombinant DNA technology: concept only. • Introduction to tools: PCR, gel electrophoresis, gene cloning (only conceptual). • Role of bioinformatics, biostatistics, and computational biology. • Introduction to basic lab techniques and biosafety norms.	**9L**
III	**Applications of Biotechnology-** • **Healthcare**: vaccines, diagnostics, gene therapy, monoclonal antibodies. • **Agriculture**: GM crops, pest resistance, improved yield. • **Industry**: enzymes, fermentation, biofuels, biodegradable plastics. • **Environment**: bioremediation, wastewater treatment, pollution control.	**9L**

IV	**Future Trends and Emerging Areas-** • Synthetic biology and genome editing (CRISPR-Cas9 – concept only). • Stem cells and regenerative medicine. • Nanobiotechnology. • Artificial Intelligence in biotech and drug discovery. • Personalized medicine and precision agriculture. • Introduction to Omics: genomics, proteomics, metabolomics.	**9L**
V	**Careers, Innovation & Bioethics-** • Career paths: R&D, pharma, agribiotech, clinical research, bioinformatics, IP and patent law, teaching. • Role of entrepreneurship and startups in biotechnology. • Introduction to intellectual property rights (IPR) and patents. • Ethics in biotechnology: cloning, GMOs, animal testing, privacy in genomics. • National and international biotech policies and institutions (e.g., DBT, CSIR, WHO, NIH).	**9L**

Text Books:
Reference Books:
1. **B.D. Singh** – *Biotechnology: Expanding Horizons*
2. **R.C. Dubey** – *A Textbook of Biotechnology*
3. **U. Satyanarayana** – *Biotechnology*
4. **Susan Barnum** – *Biotechnology: An Introduction*
5. Latest NBT/DBT/CSIR reports and articles (for trends & careers)

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	Explain the scope, importance, and evolution of biotechnology.	L2 & L3
CO-2	Identify key areas like genetic engineering, fermentation, and tissue culture.	L3 &L4
CO-3	Understand the interdisciplinary connections with biology, chemistry, and engineering.	L1& L3
CO-4	Explore future career paths and societal impacts of biotechnology.	L2 & L3
CO-5	Demonstrate awareness of global trends, ethical concerns, and innovations in biotech.	L2 & L4

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)												
CO-PO Mapping												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	2	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG (R) **Class: B.Tech. Biotechnology**			**Year: I** **Semester: I**
Credits: 4		**Category**	**VAC**
Theory	**Practical**	**Course Code**	**ENCS-111**
4	**0**	**Course Name**	**Structured Programming and Problem Solving in C**

Course Objectives:

1. To understand the basics of computers, programming languages, the history and structure of the C language, and its compilation and execution process.
2. To learn to define problems, analyze them, and create solutions using algorithms, flowcharts, and pseudo code.
3. To gain proficiency in data types, variables, constants, literals, operators, expressions, and input/output functions in C.
4. To apply conditional statements, switch-case statements, looping structures, and functions, including recursion and library functions, in C programs.
5. To Work with arrays, strings, pointers, structures, unions, file handling, preprocessor directives, and advanced data structures, and solve real-world problems through case studies and project-based learning.

Nature of Paper: VAC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of Total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit (4Hrs./Week = 4 Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION TO PROGRAMMING AND PROBLEM SOLVING:** **INTRODUCTION TO COMPUTERS AND PROGRAMMING:** Overview of computers and programming languages, History and evolution of C language, Basic structure of a C program, Compilation and execution process. **PROBLEM SOLVING TECHNIQUES:** Problem definition and analysis, Algorithms and flowcharts, Pseudocode **FUNDAMENTALS OF C:** Data types and variables, Constants and literals, Operators and expressions, Input and output functions.	**9L**
II	**CONTROL STRUCTURES AND FUNCTIONS:** **CONTROL STRUCTURES:** Conditional statements (if, if-else, nested if), Switch-case statements, looping structures (for, while, do-while), Break and continue statements, **FUNCTIONS:** Function declaration and definition, Function calling and parameter passing, Scope and lifetime of variables, Recursive functions, Library functions.	**9L**

III	**ARRAYS, STRINGS, AND POINTERS:** **ARRAYS:** One-dimensional arrays, Two-dimensional arrays, Multidimensional arrays, Array operations and applications, **STRINGS:** String handling functions, String manipulation techniques. **POINTERS:** Introduction to pointers, Pointer arithmetic, Pointers and arrays, Pointers to functions, Dynamic memory allocation.	**9L**
IV	**STRUCTURES, UNIONS, AND FILE HANDLING:** **STRUCTURES AND UNIONS:** Defining and declaring structures, Accessing structure members, Array of structures, Nested structures, Unions and their applications. **FILE HANDLING:** File operations (opening, closing, reading and writing), File modes, Sequential and random , Error handling in file access files operations.	**9L**
V	**ADVANCED TOPICS AND CASE STUDIES:** **PREPROCESSOR DIRECTIVES:** Macros, File inclusion, Conditional compilation. **ADVANCED DATA STRUCTURES:** Introduction to linked lists, Stacks and queues (concepts and basic operations). PROBLEM SOLVING CASE STUDIES: Real-world problem solving using C, Case studies and project-based learning, Debugging and testing techniques, Best practices in programming.	**9L**

Text Books:

1. *Computer Programming with C, Special Edition-MRCET, Mc Graw Hill Publishers 2017,*
2. *Computer Science: A Structured Programming Approach Using C, B, A, Forouzan and R, F, Gilberg, Third Edition, Cengage Learning,*

Reference Books:

1. *The C Programming Language, B, W, Kernighan and Dennis M, Ritchie, PHI*
2. *Computer Programming, E, Balagurusamy, First Edition, TMH*
3. *C and Data structures – P, Padmanabham, Third Edition, B, S, Publications,*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	**Max, Marks**
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Students will demonstrate an understanding of the fundamentals of computers, and evolution of the C programming language, the basic structure of a C program, and the compilation and execution processes.	**L2 & L3**
CO-2	Students will be able to define and analyze programming problems, develop	**L1,L2& L3**

	algorithms, create flowcharts, and write pseudo code to design effective solutions.	
CO-3	Students will gain proficiency in fundamentals of C and will be able to implement basic input and output functions.	**L1,L2& L3**
CO-4	Students will be able to apply conditional statements, switch-case statements, and looping structures to control program flow, and will understand function declaration, definition, calling, parameter passing, scope, lifetime of variables, and recursion.	**L2,L3 & L4**
CO-5	Students will demonstrate the ability to work with arrays, strings, and pointers, define and utilize structures and unions, perform file operations, and understand advanced data structures like linked lists, stacks, and queues. They will also be able to solve real- world problems using C.	**L2,L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Structured Programming and Problem Solving in C (RTCS-111)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	1	0	0	0	1	2	3
CO-2	3	3	3	2	1	1	0	0	0	1	1	3
CO-3	3	3	3	3	1	0	0	0	0	0	1	3
CO-4	3	3	3	2	2	1	0	0	0	1	2	3
CO-5	3	3	3	3	2	1	0	0	0	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG (R) **Class: B.Tech. Biotechnology**			**Year: I** **Semester: I & II**
Credits		**Category**	**AECC**
Theory	**Practical**	**Course Code**	**ENAS-114/ ENAS-124**
4	**NA**	**Course Name**	**Professional Communication and Digital fluency**

Course Objectives:

1. To understand and apply basic principles of professional communication, including the communication process and overcoming barriers.
2. To enhance the essentials of technical writing for engineering, including reports, documentation, professional emails, and proposals.
3. To gain confidence in public speaking, create effective presentations, and learn to engage different audiences.
4. To develop skills for building rapport, effective teamwork, conflict resolution, and leadership communication.
5. To learn to effectively use digital communication tools, social media, and adapt to emerging trends in global engineering contexts.

Nature of Paper: AECC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of Total)

L : 3	**T : 1**	**P : 0**	**C : 4**

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit (4 Hrs./Week = 4 Credits)

Units	**Contents**	**No. of Lectures Allotted**
I	Fundamentals of Communication: Definition and importance, Communication process, Verbal and non-verbal communication, Barriers to communication, Formal and informal communication.	9L
II	Professional Speaking and Presentation Skills: Public speaking, Group discussion, Effective oral communication, Use of visual aids, Body language, Elevator pitch, Presentation planning and delivery. Proposal writing exercises	9L
III	Business and Technical Writing: Email etiquette, Resume and cover letter writing, Report writing, Technical documentation, Memos, Minutes of meetings.	9L
IV	Digital Literacy and Collaboration Tools: Digital platforms for communication (Zoom, Teams, Slack), Cloud collaboration (Google Docs, One Drive), Etiquette of digital communication, Netiquette, Cyber safety.	9L
V	Professionalism and Work Ethics: Workplace behavior, Teamwork, Leadership communication, Conflict resolution, Time management, Building online presence through LinkedIn and digital portfolios.	9L

Text Books and Reference Books:

1. "Technical Communication: A Practical Approach" by William Sanborn Pfeiffer and Kaye E. Adkins.
2. "The Essentials of Technical Communication" by Elizabeth Tebeaux and Sam Dragga
3. "Engineering Communication" by Charles W. Knisely and Karin I. Knisely
4. "Communicating in Groups: Applications and Skills" by Katherine Adams, Gloria Galanes, and Brandi R. Fritz "Digital Communications: Fundamentals and Applications" by Bernard Sklar

If the course is available as Generic Elective, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: English of Class 12

Course Learning Outcomes:

CO-1	Demonstrate effective communication skills, including verbal, non-verbal, and written, in professional engineering contexts.	L2 & L3
CO-2	Develop clear, concise, and coherent technical documents, including reports, project documentation, and professional emails.	L3 &L4
CO-3	Deliver engaging and informative oral presentations tailored to diverse audiences, utilizing effective visual aids and presentation techniques.	L1& L3
CO-4	Exhibit strong interpersonal and teamwork skills, including active listening, conflict resolution, and leadership communication.	L2 & L3
CO-5	Utilize digital communication tools and social media platforms to enhance professional networking and collaboration, adapting to emerging communication trends and global engineering contexts.	L2 & L4

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Effective Engineering Communication (RTAS-114)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech. Biotechnology**			**Year: I** **Semester: I/II**
Credits: 4		**Category**	**AECC**
Theory	**Practical**	**Course Code**	**ENHU NPR-112/ ENHU NPR 112P**
4	**NA**	**Course Name**	**CLIMATE CHANGE AND ENVIRONMENTAL SUSTAINIBILITY**

Course Objectives:

1. To introduce students to the interrelationship between humans and the environment, tracing historical, cultural, and ethical dimensions of sustainability.
2. To equip students with knowledge about natural resources, biodiversity, ecosystems, and their conservation strategies.
3. To raise awareness of major environmental issues local to global—such as pollution, climate change, land degradation, and disaster risk.
4. To familiarize students with environmental laws, policies, and international treaties related to environmental governance and sustainable development.
5. To encourage experiential learning through field visits, case studies, and hands-on campus environmental management activities.

Nature of Paper: AECC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of Total)

L : 3	**T : 1**	**P : 0**	**C : 4+1**

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit (4 Hrs./Week = 4 Credits)

Units	**Contents**	**No. of Lectures Allotted**
I	**Humans and the Environment:** The man-environment interaction: Humans as hunter-gatherers; Mastery of fire; Origin of agriculture; Emergence of city-states; Great ancient civilizations and the environment, Indic Knowledge and Culture of sustainability; Middle Ages and Renaissance; Industrial revolution and its impact on the environment; Population growth and natural resource exploitation; Global environmental change. **Environmental Ethics and emergence of environmentalism**: Anthropocentric and eco-centric perspectives (Major thinkers); The Club of Rome- Limits to Growth; UN Conference on Human Environment 1972; World Commission on Environment and Development and the concept of sustainable development; Rio Summit and subsequent international efforts.	**9L**
II	**Natural Resources and Sustainable Development**: Overview of natural resources: Definition of resource; Classification of natural resources- biotic and abiotic, renewable and non-renewable. **Biotic resources**: Major type of biotic resources- forests, grasslands, wetlands, wildlife and aquatic (fresh water and marine); Microbes as a	**9L**

	resource; Status and challenges. **Water resources**: Types of water resources-fresh water and marine resources; Availability and use of water resources; Environmental impact of over-exploitation, issues and challenges; Water scarcity and stress; Conflicts over water. **Soil and mineral resources**: Important minerals; Mineral exploitation; Environmental problems due to extraction of minerals and use; Soil as a resource and its degradation. **Energy resources**: Sources of energy and their classification, renewable and non-renewable sources of energy; Conventional energy sources- coal, oil, natural gas, nuclear energy; Non-conventional energy sources- solar, wind, tidal, hydro, wave, ocean thermal, geothermal, biomass, hydrogen and fuel cells; Implications of energy use on the environment. **Introduction to sustainable development**: Sustainable Development Goals (SDGs) - targets and indicators, challenges and strategies for SDGs.	
III	**Environmental Issues: Local, Regional and Global:** **Environmental issues and scales**: Concepts of micro-, meso-, synoptic and planetary scales; Temporal and spatial extents of local, regional, and global phenomena. **Pollution**: Impact of sectoral processes on Environment; Types of Pollution- air, noise, water, soil, thermal, radioactive; municipal solid waste, hazardous waste; transboundary air pollution; acid rain; smog. Land use and Land cover change: land degradation, deforestation, desertification, urbanization. Biodiversity loss: past and current trends, impact. **Global change**: Ozone layer depletion; Climate change. Disasters–Natural and Man-made	**9L**
IV	**Conservation of Biodiversity and Ecosystems:** Biodiversity and its distribution: Biodiversity as a natural resource; Levels and types of biodiversity; Biodiversity in India and the world; Biodiversity hotspots; Species and ecosystem threat categories. **Ecosystems and ecosystem services**: Major ecosystem types in India and their basic characteristics-forests, wetlands, grasslands, agriculture, coastal and marine; Ecosystem services- classification and their significance. Threats to biodiversity and ecosystems: Land use and land cover change; Commercial exploitation of species; Invasive species; Fire, disasters and climate change. **Major conservation policies**: in-situ and ex-situ conservation approaches; Major protected areas; National and International Instruments for biodiversity conservation; the role of traditional knowledge, community-based conservation; Gender and conservation.	**9L**
V	**Environmental Pollution and Health:** Understanding pollution: Production processes and generation of wastes; Assimilative capacity of the environment; Definition of pollution; Point sources and non-point sources of pollution. **Air pollution: Sources of air pollution;** Primary and secondary pollutants; Criteria pollutants-carbon monoxide, lead, nitrogen oxides, ground-level ozone, particulate matter and sulphur dioxide; Other	**9L**

	important air pollutants-Volatile Organic compounds (VOCs), Peroxyacetyl Nitrate (PAN), Polycyclic aromatic hydrocarbons (PAHs) and Persistent organic pollutants (POPs); Indoor air pollution; Adverse health impacts of air pollutants; National Ambient Air Quality Standards. Water pollution: Sources of water pollution; River, lake and marine pollution, groundwater pollution; water quality Water quality parameters and standards; adverse health impacts of water pollution on human and aquatic life. **Soil pollution and solid waste:** Soil pollutants and their sources; Solid and hazardous waste; Impact on human health. **Noise pollution: Definition of noise;** Unit of measurement of noise pollution; Sources of noise pollution; Noise standards; adverse impacts of noise on human health. Thermal and Radioactive pollution: Sources and impact on human health and ecosystems.	
VI	**Climate Change: Impacts, Adaptation and Mitigation:** Understanding climate change: Natural variations in climate; Structure of atmosphere; Anthropogenic climate change from greenhouse gas emissions– past, present and future; Projections of global climate change with special reference to temperature, rainfall, climate variability and extreme events; Importance of 1.5 °C and 2.0 °C limits to global warming; Climate change projections for the Indian sub-continent**.** **Impacts, vulnerability and adaptation to climate change:** Observed impacts of climate change on ocean and land systems; Sea level rise, changes in marine and coastal ecosystems; Impacts on forests and natural ecosystems; Impacts on animal species, agriculture, health, urban infrastructure; the concept of vulnerability and its assessment; Adaptation vs. resilience; Climate-resilient development; Indigenous knowledge for adaptation to climate change**.** **Mitigation of climate change**: Synergies between adaptation and mitigation measures; Green House Gas (GHG) reduction vs. sink enhancement; Concept of carbon intensity, energy intensity and carbon neutrality; National and international policy instruments for mitigation, decarbonizing pathways and net zero targets for the future; Energy efficiency measures; Renewable energy sources; Carbon capture and storage, National climate action plan and Intended Nationally Determined Contributions (INDCs); Climate justice.	**9L**
VII	**Environmental Management**: Introduction to environmental laws and regulation: Constitutional provisions- Article 48A, Article 51A (g) and other derived environmental rights; Introduction to environmental legislations on the forest, wildlife and pollution control. **Environmental management system**: ISO 14001 Concept of Circular Economy, Life cycle analysis; Cost-benefit analysis Environmental audit and impact assessment; Environmental risk assessment Pollution control and management; Waste Management- Concept of 3R (Reduce, Recycle and Reuse) and sustainability; Eco-labeling/Eco-mark scheme.	**9L**
VIII	**Environmental Treaties and Legislation**: An overview of instruments of	**9L**

	international cooperation; bilateral and multilateral agreements; conventions and protocols; adoption, signature, ratification and entry into force; binding and non- binding measures; Conference of the Parties (COP) **Major International Environmental Agreements**: Convention on Biological Diversity (CBD); Cartagena Protocol on Biosafety; Nagoya Protocol on Access and Benefit-sharing; **Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES);** Ramsar Convention on Wetlands of International Importance; United Nations Convention to Combat Desertification (UNCCD); Vienna Convention for the Protection of the Ozone Layer; Montreal Protocol on Substances that Deplete the Ozone Layer and the Kigali Amendment; Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal; Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade; Stockholm Convention on Persistent Organic Pollutants; Minamata Convention on Mercury; United Nations Framework Convention on Climate Change (UNFCCC); Kyoto Protocol; Paris Agreement; India's status as a party to major conventions **Major Indian Environmental Legislations**: The Wild Life (Protection) Act, 1972; The Water (Prevention and Control of Pollution) Act, 1974; The Forest (Conservation) Act, 1980; The Air (Prevention and Control of Pollution) Act, 1981; The Environment (Protection) Act, 1986; The Biological Diversity Act, 2002; The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006; Noise Pollution (Regulation and Control) Rules, 2000; Industry-specific environmental standards; Waste management rules; Ramsar sites; Biosphere reserves; Protected Areas; Ecologically Sensitive Areas; Coastal Regulation Zone; Status phase-out of production and consumption of Ozone Depleting Substances by India; National Green Tribunal; Some landmark Supreme Court judgements **Major International organizations and initiatives**: United Nations Environment Programme (UNEP), International Union for Conservation of Nature (IUCN), World Commission on Environment and Development (WCED), United Nations Educational, Scientific and Cultural Organization (UNESCO), Intergovernmental Panel on Climate Change (IPCC), and Man and the Biosphere (MAB) programme.	
IX	**Case Studies and Field Work** : The students are expected to be engaged in some of the following or similar identified activities: 1. Discussion on one national and one international case study related to the environment and sustainable development. 2. Field visits to identify local/regional environmental issues, make observations including data collection and prepa re a brief report. 3. Participation in plantation drive and nature camps. 4. Documentation of campus biodiversity. 5. Campus environmental management activities such as solid waste disposal, water Management and sanitation, and sewage treatment.	**9L**

Reference Books:

1. Fisher, Michael H. (2018) An Environmental History of India- From Earliest Times to the Twenty-First Century, Cambridge University Press.
2. Hedrick, Daniel R. (2020) Humans versus Nature- A Global Environmental History, Oxford University Press.
3. Hughes, J. Donald (2009) An Environmental History of the World- Humankind's Changing Role in the Community of Life, 2nd Edition. Routledge.
4. Perman, R., Ma, Y., McGillivray, J., and Common, M. (2003) Natural Resource and Environmental Economics. Pearson Education.
5. Simmons, I. G. (2008). Global Environmental History: 10,000 BC to AD 2000. Edinburgh University Press
6. Chiras, D. D and Reganold, J. P. (2010). Natural Resource Conservation: Management for a Sustainable Future.10th edition, Upper Saddle River, N. J. Benjamin/Cummins/Pearson.
7. John W. Twidell and Anthony D. (2015). Renewable Energy Sources, 3rd Edition, Weir Publisher (ELBS)
8. William P.Cunningham and Mary A. (2015) Cunningham Environmental Science: A Global Concern, Publisher (Mc-Graw Hill, USA)
9. Gilbert M. Masters and W. P. (2008). An Introduction to Environmental Engineering and Science, Ela Publisher (Pearson)
10. Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications https://sdgs.un.org/goals
11. Harper, Charles L. (2017) Environment and Society, Human Perspectives on Environmental Issues 6th Edition. Routledge.
12. Harris, Frances (2012) Global Environmental Issues, 2nd Edition. Wiley- Blackwell.
13. William P. Cunningham and Mary A. (2015). Cunningham Environmental Science: A global concern, Publisher (Mc-Graw Hill, USA)
14. Manahan, S.E. (2022). Environmental Chemistry (11th ed.). CRC Press. https://doi.org/10.1201/9781003096238
15. Rajagopalan, R. (2011). Environmental Studies: From Crisis to Cure. India: Oxford University Press.
16. Bawa, K.S., Oomen, M.A. and Primack, R. (2011) Conservation Biology: A Primer for South Asia. Universities Press.
17. Sinha, N. (2020) Wild and Wilful. Harper Collins, India.
18. Varghese, Anita, Oommen, Meera Anna, Paul, Mridula Mary, Nath, Snehlata (Editors) (2022) Conservation through Sustainable Use: Lessons from India. Routledge.
19. Bhagwat, Shonil (Editor) (2018) Conservation and Development in India: Reimagining Wilderness, Earthscan Conservation and Development, Routledge.
20. Krishnamurthy, K.V. (2003) Textbook of Biodiversity, Science Publishers, Plymouth, UK
21. Jackson, A. R., & Jackson, J. M. (2000). Environmental Science: The Natural Environment and Human Impact. Pearson Education.
22. Masters, G. M., & Ela, W. P. (2008). *Introduction to environmental engineering and science* (No. 60457). Englewood Cliffs, NJ: Prentice Hall.
23. Miller, G. T., & Spoolman, S. (2015) Environmental Science. Cengage Learning.
24. Central Pollution Control Board Web page for various pollution standards. https://cpcb.nic.in/standards/
25. Ahluwalia, V. K. (2015). *Environmental Pollution, and Health*. The Energy and Resources Institute (TERI).
26. Pittock, Barrie (2009) Climate Change: The Science, Impacts and Solutions. 2nd Edition. Routledge.

27. www.ipcc.org; https://www.ipcc.ch/report/sixth-assessment-report-cycle/.
28. Adenle A., Azadi H., Arbiol J. (2015). Global assessment of technological innovation for climate change adaptation and mitigation in developing world, Journal of Environmental Management, 161 (15): 261-275.
29. Barnett, J. & S. O'Neill (2010). Maladaptation. Global Environmental Change—Human and Policy Dimensions 20: 211–213.
30. Berrang-Ford, L., J.D. Ford & J. Paterson (2011). Are we adapting to climate change? Global Environmental Change—Human and Policy Dimensions 21: 25-33.
31. Jørgensen, Sven Marques, Erik João Carlos and Nielsen, Søren Nors (2016) Integrated Environmental Management, A transdisciplinary Approach. CRC Press.
32. Theodore, M. K. and Theodore, Louis (2021) Introduction to Environmental Management, 2nd Edition. CRC Press.
33. Barrow, C. J. (1999). Environmental management: Principles and practice. Routledge.
34. Tiefenbacher, J (ed.) (2022), Environmental Management - Pollution, Habitat, Ecology, and Sustainability, Intech Open, London. 10.5772/
35. Richard A. Marcantonio, Marc Lame (2022). Environmental Management: Concepts and Practical Skills. Cambridge University Press.
36. UNEP (2007) Multilateral Environmental Agreement Negotiator's Handbook, University of Joensuu, ISBN 978-952-458-992-5
37. Ministry of Environment, Forest and Climate Change (2019) A Handbook on International Environment Conventions & Programmes. https://moef.gov.in/wp- content/uploads/2020/02/ convention-V-16-CURVE-web.pdf
38. Kanchi Kohli and Manju Menon (2021) Development of Environment Laws in India, Cambridge University Press.
39. India Code – Digital repository of all Central and State Acts: https://www.indiacode.nic.in/
40. Bohra, Saroj, Judicial Intervention and Evolution of Environmental Principles and Doctrines (January 7, 2019). Available at SSRN: https://ssrn.com/abstract=3311406 or http://dx.doi. org/10.2139/ssrn.3311406

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology	
Category	**Max. Marks**
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Course Learning Outcomes:		
CO1	Explain the evolution of human-environment interaction, environmental ethics, and sustainability principles.	L2
CO2	Classify natural resources and evaluate their usage, challenges, and conservation strategies.	L3
CO3	Analyze local, regional, and global environmental issues, including pollution, biodiversity loss, and land use change.	L4

CO4	Interpret the causes, consequences, and mitigation strategies of climate change and global environmental change.	L3
CO5	Describe key environmental policies, laws, and treaties at national and international levels.	L2

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Environment and Ecology/ Environment and Ecology Lab (NHU NPR-112/ NHU NPR 112P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO1	2	1	1	1	1	2	3	2	1	2	0	2
CO2	2	2	2	2	1	2	3	2	0	1	0	3
CO3	1	2	2	2	1	3	3	2	1	2	0	3
CO4	2	2	2	2	2	3	3	2	1	2	0	3
CO5	2	1	1	1	1	3	3	3	0	2	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech. Biotechnology**			**Year: I** **Semester: I & II**
Credits: 2		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENAS-112P/ ENAS-122P**
NA	**2**	**Course Name**	**MODERN PHYSICS IN ENGINEERING LAB**

Course Objectives:

1. To understand the concept of wave length by the interference
2. To understand the concept of wave length by the diffraction.
3. To understand the concept of viscosity of liquid and flow of liquid
4. To understand the energy band gap in the semiconductors
5. To understand the concept of polarization

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Marks (50% of Internal Assessment & 50% of External Assessment)

L : 0	**T : 0**	**P : 2**	**C : 2**

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit (4 Hrs./Week = 4 Credits)

Units	**Practical Title**
Practical-1.	To determine the wavelength of Sodium light by Newton's rings
Practical-2.	To determine the wavelength of prominent lines of mercury by plane diffraction grating
Practical-3.	To determine the focus length combination of two lenses separated by distance and verify the formula for the focal length of combination of lenses
Practical-4.	To determine the wave length of sodium light with the help of Fresnel's bi-prism
Practical-5.	To determine the coefficient of viscosity of a given liquid
Practical-6.	To verify Stefan's law
Practical-7.	Calibration of a volt meter with potentiometer
Practical-8.	To determine the resistance per unit length and specific resistance of a given resistance using Carey Foster 's Bridge
Practical-9.	To determine the energy bend gap of a given semiconductor material
Practical-10.	To determine the Specific Rotation of the Cane sugar solution with the help of Polarimeter

Reference/Text Books:

1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*

Evaluation/Assessment Methodology

Category	**Internal/External**	**Max. Marks**
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
	Total:	**50**

Course Learning Outcomes:		
CO-1	To determine the wavelength of sodium light by Newton's ring experiment	**L3**
CO-2	To determine the wavelength of sodium light with the help of Fresnel's bi-prism	**L3**
CO-3	To determine the viscosity of liquid.	**L3**
CO-4	To determine the emission of energy with respect the temperature and verify Stefan's law.	**L3 & L4**
CO-5	To determine the calibration of potential and draw the curve.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Engineering Physics Lab(RTAS-112P/ RTAS-122P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	2	0	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	2	2	1	0	0	0	0	0	0	2	2
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG (R) **Class: B.Tech. Biotechnology**			**Year: I** **Semester: I & II**
Credits: 2		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENAS-113P/ ENAS-123P**
NA	**2**	**Course Name**	**Engineering Chemistry Lab**

Course Objectives:

1. Student will be able to Estimate different impurities present in water sample.
2. Student will be able to Determine molecular properties such as surface tension, viscosity, pH, conductance and concentration of solution.
3. Student will be able to Identify iron concentration and percentage of available chlorine in supplied sample using titration methods

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	**T : 0**	**P : 2**	**C : 2**

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit (4 Hrs./Week = 4 Credits)

Units	**Practical Title**
Practical-1.	To determine total alkalinity in the given water sample.
Practical-2.	To determine the temporary and permanent hardness in water sample using EDTA as standard solution.
Practical-3.	To determine the available chlorine in bleaching powder solution.
Practical-4.	To determine the chloride content in the given water sample by Mohr's method.
Practical-5.	To determine the pH of the given solution using pH meter and pH-metric titration.
Practical-6.	To determine the Equivalent weight of Iron by the chemical displacement method.
Practical-7.	To determine the Viscosity of an addition polymer like polyester by Viscometer.
Practical-8.	To find chemical oxygen demand of waste water sample by potassium dichromate
Practical-9.	To determine the iron content in the given sample using external indicator
Practical-10.	To determine the strength of given HCL solution by titrating against N/10 Standard Sodium hydroxide solution

Reference/Text Books:

1. *B. S. Grewal, Higher Engineering Mathematics, Khanna Publisher, 2005.*
2. *B. V. Ramana, Higher Engineering Mathematics, McGraw-Hill Publishing Company Ltd., 2008.*
3. *Dass H.K., Engineering Mathematics Vol-I, S. Chand.*

Evaluation/Assessment Methodology

Category	**Internal/External**	**Max. Marks**
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce (External)		10
5) Practical Records		05
	Total:	**50**

Course Learning Outcomes:

CO-1	Estimate different impurities present in water sample.	**L4**

CO-2	Determine molecular properties such as surface tension, viscosity, pH, conductance and concentration of solution	**L3**
CO-3	Identify iron concentration and percentage of available chlorine in supplied sample using titration methods.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Engineering Chemistry Lab(RTAS-113P/ RTAS-123P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	0	2	1	0	0	0	0	0	1	2
CO-2	3	3	2	2	0	0	0	0	0	0	1	2
CO-3	3	3	3	1	0	0	0	0	0	0	2	1
CO-4	3	3	2	1	0	0	0	0	0	0	1	2
CO-5	3	2	2	2	0	0	0	0	0	0	2	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG (R) **Class: B.Tech. Biotechnology**			**Year: I** **Semester: I/II**
Credits: 2		**Category**	**VAC**
Theory	**Practical**	**Course Code**	**ENCS-111P**
NA	**2**	**Course Name**	**PROGRAMMING WITH C LAB: HANDS ON LOGIC BUILDING**

Course Objectives:

1. To develop proficiency in implementing fundamental programming constructs such as loops, conditionals, functions, and arrays in C language through hands-on lab exercises.
2. To Gain practical experience in implementing and using data structures like arrays, linked lists, stacks, and queues to solve programming problems during lab sessions.
3. To Enhance problem-solving skills by applying algorithms learned in theory to practical programming tasks.
4. To engage in project-based learning activities where students work in teams to tackle larger programming projects.
5. To acquire skills in debugging and error handling techniques by identifying and resolving common programming errors encountered during lab exercises, ensuring robust and error-free code.

Nature of Paper: VAC (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	**T : 0**	**P : 2**	**C : 2**

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit (4 Hrs./Week = 4 Credits)

Units	**Practical Title**
Practical-1.	Develop a program that performs basic arithmetic operations (addition, subtraction, multiplication, division) based on user input.
Practical-2.	Create a program to convert temperatures between Celsius, Fahrenheit, and Kelvin.
Practical-3.	Build a basic ATM simulation that allows users to check balance, deposit, and withdraw money.
Practical-4.	Develop a program to simulate a simple voting system with options and tallying votes.
Practical-5.	Create a program to calculate student grades based on user input of marks.
Practical-6.	Write a program that identifies whether a number is odd or even.
Practical-7.	Develop a program to check if a given year is a leap year.
Practical-8.	Create a program to solve quadratic equations.
Practical-9.	Implement a menu-driven program that performs different tasks like calculating area, volume, etc., based on user choice.
Practical-10.	Develop a recursive function to compute the factorial of a number.
Practical-11.	Develop a program to store and manipulate student marks using arrays. Calculate average, highest, and lowest marks.
Practical-12.	Implement a program to perform multiplication of two matrices.
Practical-13.	Create a function to reverse a string without using library functions.
Practical-14.	Write a program to dynamically allocate memory for an array and perform operations on it (e.g., finding the maximum element).

Practical-15.	Implement linear and binary search algorithms to find an element in an array
Practical-16.	Develop a program to check if a given string is a palindrome.
Practical-17.	Create a function that swaps two variables using pointers.
Practical-18.	Write a program to count the frequency of each character in a string.
Practical-19.	Develop a program to dynamically resize an array as elements are added or removed.
Practical-20.	Implement a function to concatenate two strings without using library functions.
Practical-21.	Create a program to manage employee records using structures.
Practical-22.	Implement a program to store and retrieve student details using file handling.
Practical-23.	Write a program to copy contents from one file to another.
Practical-24.	Create a payroll system that calculates and displays employee salaries, storing the data in files.
Practical-25.	Implement an inventory management system to track products using structures and file handling.
Practical-26.	Develop a program to manage patient records using structures and files.
Practical-27.	Create a program to demonstrate file error handling techniques.
Practical-28.	Write a program to generate student grade reports and save them in a file.
Practical-29.	Implement a singly linked list with operations like insertion, deletion, and traversal.
Practical-30.	Create a program to implement stack operations using arrays and linked lists.
Practical-31.	Develop a program to simulate a queue using arrays and linked lists.
Practical-32.	Write a program to count the number of words in a text file.
Practical-33.	Implement a program using macros for basic arithmetic calculations.
Practical-34.	Develop a program to recursively list all files in a directory (if operating system access is allowed).
Practical-35.	Implement a basic Sudoku solver using backtracking and recursion.
Practical-36.	Develop a comprehensive project simulating bank transactions including account creation, deposit, withdrawal, and balance inquiry, integrating structures, file handling, and dynamic memory allocation.

Text Books:

1. *Computer Programming with C, Special Edition-MRCET, Mc Graw Hill Publishers 2017,*
2. *Computer Science: A Structured Programming Approach Using C, B, A, Forouzan and R, F, Gilberg, Third Edition, Cengage Learning,*

Reference Books:

1. *The C Programming Language, B, W, Kernighan and Dennis M, Ritchie, PHI*
2. *Computer Programming, E, Balagurusamy, First Edition, TMH*
3. *C and Data structures – P, Padmanabham, Third Edition, B, S, Publications,*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Able to develop programs that perform fundamental arithmetic operations	**L2 & L3**
CO-2	Ale to use arrays, pointers, and structures by creating programs for matrix multiplication, student mark storage, employee records management, and	**L3 &L4**

	dynamically resizing arrays	
CO-3	Able to implement recursive functions, linear and binary search algorithms	**L1& L3**
CO-4	will learn to manage data using file handling techniques, including storing and retrieving student details, copying file contents, generating grade reports, and handling file errors, essential for real-world applications	**L2 & L3**
CO-5	will apply their theoretical knowledge to practical, real-life scenarios, integrating multiple programming concepts seamlessly	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Structured Programming and Problem Solving in C
Lab(RTCS-111P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	1	0	0	0	1	2	3
CO-2	3	3	3	2	1	1	0	0	0	1	1	3
CO-3	3	3	3	3	1	0	0	0	0	0	1	3
CO-4	3	3	3	2	1	1	0	0	0	1	2	3
CO-5	3	3	3	3	2	1	0	0	0	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Program: UG(R) **Class: B.Tech. Biotechnology**			**Year: I** **Semester: I/II**
Credits: 2		**Category**	**AECC**
Theory	**Practical**	**Course Code**	**ENAS-114P/ ENAS-124P**
NA	**2**	**Course Name**	**PROFESSIONAL COMMUNICATION LAB**

Course Objectives:

1. To enhance students' ability to communicate effectively in social and professional settings
2. To focus on the correct pronunciation and intonation patterns of English to ensure clear and understandable speech
3. To provide a solid foundation in English grammar and expand vocabulary for more accurate and expressive language use
4. To develop active listening skills and improve comprehension abilities through focused practice and exercises
5. To equip students with essential soft skills such as interview handling, email etiquette, and presentation skills to succeed in professional environments.

Nature of Paper: AECC (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0	T: 0	P: 2	C: 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit (4 Hrs./Week = 4 Credits)

Units	Practical Title(English-Wordsworth-Language Lab)
Module-1.	**Communication Skills –** 1. Social Meeting People & Asking Questions 2. Making Friends 3. Dos & Don'ts 4. What do you do?
Module-2.	**English Concepts –** 1. Tenses 2. Parts of Speech 3. Figures of Speech 4. Direct & Indirect Speech
Module-3.	**Pronunciation –** 1. Phonetics & Intonations 2. Vowels, Consonants, Nouns
Module-4.	**Communication Skills –** 1. Listening Skills 2. Speaking Skills 3. Reading Skills 4. Writing Skills
Module-5.	**Advance Learning &** **Soft Skills –** 1. Effective Communication 2. Interview Handling Skills 3. Email Etiquette

	4. Presentation Skills 5. Listening Comprehension

Text Books/Reference Books:

1. Daniel Jones: English Pronouncing Dictionary
2. R.K. Bansal: Phonetics in English
3. Sethi and Dhamija: A Course in English Phonetics
4. S.D. Sharma: A Text-Book of Professional Communication & ESP
5. S.D. Sharma: Manual on Communication Lab English

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		50

Course Learning Outcomes:

CO-1	Students will demonstrate improved ability to meet and engage with people, make friends, and handle social interactions confidently and appropriately	**L2 & L3**
CO-2	Students will exhibit correct pronunciation, intonation, and the ability to articulate vowels, consonants, and nouns clearly	**L3 &L4**
CO-3	Students will show proficiency in using tenses, parts of speech, and figures of speech in both written and spoken English	**L1& L3**
CO-4	Students will display heightened listening skills and the ability to comprehend and respond accurately to spoken and written English	**L1 & L4**
CO-5	Students will be able to effectively manage interviews, compose professional emails, and deliver impactful presentations, showcasing their preparedness for professional scenarios	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Effective Engineering Communication Lab (RTAS-114P/ RTAS-124P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	1	0	2	2	2	1	0	0	0	0	2	2
CO-2	1	3	2	2	2	1	0	0	0	0	1	2
CO-3	0	2	2	2	1	0	0	0	0	0	1	2
CO-4	1	3	2	2	2	0	0	0	0	0	1	1
CO-5	1	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG (R) **Class: B.Tech. Biotechnology**			**Year: I** **Semester: I/II**
Credits: 2		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENEE-111P/ ENEE-121P**
NA	**2**	**Course Name**	**ELECTRONICS IN THE MODERN WORLD LAB**

Course Objectives:

1. To analyze a given network by applying various electrical laws.
2. To analyze a given network by applying various electrical network theorems
3. To know the response of electrical circuits for different excitations
4. To calculate, measure and know the relation between basic electrical parameters
5. To calculate, measure and know the relation between basic electronics Parameters

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0	**T: 0**	**P: 2**	**C: 2**

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit (4 Hrs./Week = 4 Credits)

Units	**Practical Title**
Practical-1.	Verification of Ohms Law.
Practical-2.	Verification of KCL and KVL for DC Circuits.
Practical-3.	Verification of Superposition Theorem.
Practical-4.	Verification of Thevenin`s Theorem
Practical-5.	Verification of Norton`s Theorem
Practical-6.	Verification of Maximum Power Transfer Theorem
Practical-7.	Calculations and Verification of Impedance and Current of RL, RC and RLC series Circuits.
Practical-8.	Measurement of Voltage, Current and Real Power in primary and Secondary AC Circuits
Practical-9.	The identification & Testing of Electronic component.
Practical-10.	Diode Characteristics(Si) a) Forward Bias b) Reverse Bias
Practical-11.	Study and analysis of half Wave rectifier with & without filter.
Practical-12.	Study and analysis of full Wave rectifier with & without filter.
Practical-13.	Transistor CE Characteristics (I/P & O/P)

Text Books:

1. Robert L. Boylestand / Louis Nashelsky "Electronic Devices and Circuit Theory", Pearson Education.
2. R. Muthusubramanian, S. Salivahanan, "Basic Electrical and Electronics Engineering", Tata McGraw-Hill Education, Reprint 2012
3. George Kennedy, "Electronic Communication Systems", McGraw Publication

Reference Books:

1. David A. Bell, "Electronic Devices and Circuits", Oxford University Press.
2. Jacob Millman, C.C. Halkias, StayabrataJit, "Electronic Devices and Circuits", McGraw Hill
3. David A. Bell, Electronic Instrumentation and Measurements, Latest Edition, Oxford Uni Press India

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Create basic electrical connections for domestic applications	**L2 & L3**
CO-2	Measure the various electrical parameters in the DC circuit	**L3 &L4**
CO-3	Measure the various electrical parameters in the AC circuit	**L1& L3**
CO-4	To study basic electronic components.	**L2 & L3**
CO-5	To get the practical expose of the Transistors applications.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Introduction to Electrical & Electronics Engineering Lab (RTEE-111P/ RTEE-121P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	3	2	2	2	1	0	0	0	0	1	2
CO-3	3	3	2	2	1	0	0	0	0	0	1	2
CO-4	3	3	2	2	2	0	0	0	0	0	1	1
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech. Biotechnology**			**Year: I** **Semester: I**
Credits: 2		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENBT-113P/ENBT-123P**
NA	**2**	**Course Name**	**Biotechnology Lab**

Course Objectives:

1. To develop practical skills related to basic biotechnology laboratory work
2. To familiarize students with safe lab practices, equipment handling, and standard operating procedures.
3. To introduce basic techniques used in microbiology, molecular biology, and biochemistry.
4. To demonstrate the relationship between theory and experimentation.
5. To prepare students for advanced practical courses in biotechnology.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	**T :** 0	**P :** 2	**C :** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit (4 Hrs./Week = 4 Credits)

Units	**Practical Title**
Practical-1	Introduction to lab safety, biosafety levels, and waste disposal.
Practical-2	Identification and use of common lab equipment: micropipettes, centrifuge, pH meter, autoclave.
Practical-3	Qualitative tests for carbohydrates (Molisch, Benedict, Iodine test).
Practical-4	Protein estimation (Biuret or Lowry method – demonstration).
Practical-5	Lipid test (grease spot, Sudan III staining).
Practical-6	Staining and observation of plant and animal cells under microscope.
Practical-7	Study of cell structure using onion peel and cheek cells.
Practical-8	Preparation of culture media (nutrient agar).
Practical-9	Aseptic techniques and streak plating for bacterial culture.
Practical-10	Observation of microbial colonies (color, shape, elevation, etc).
Practical-11	Isolation of DNA from plant (e.g., spinach or banana).
Practical-12	Demonstration: Gel electrophoresis for DNA separation (if facilities available).
Practical-13	Preparation of buffers (e.g., PBS or Tris buffer).

Reference/Text Books:

- **Introductory Biotechnology Lab Manual** – K.R. Aneja
- **Practical Biotechnology** – R.C. Dubey
- **Laboratory Manual in Biochemistry and Biotechnology** – Manisha Saxena
- CBSE/NCERT Biology Practical Book (11th/12th, relevant sections).

Evaluation/Assessment Methodology

Category	**Internal/External**	**Max. Marks**
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External	20
4) Presentation/Seminar/Viva-Voce(External)		10

5) Practical Records	Assessment	05
Total:		**50**

Course Learning Outcomes:

CO-1	Demonstrate safe laboratory practices and correct use of lab equipment.	**L2 & L3**
CO-2	Identify and analyze basic biomolecules through qualitative tests.	**L3 &L4**
CO-3	Apply microscopy techniques to visualize cells.	**L1& L3**
CO-4	Perform basic microbiology techniques such as media preparation and culturing.	**L2 & L3**
CO-5	Extract DNA and understand principles behind biotechnology techniques like electrophoresis.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Engineering Physics Lab(RTAS-112P)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech. Biotechnology**			**Year: I** **Semester: II**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENMS-121**
4	**NA**	**Course Name**	**Foundational Math Skills-II**

Course Objectives:

1. To apply the concepts of coordinate geometry in engineering.
2. To deal with vector algebra that is required in Biotechnology engineers.
3. The concepts of probability in a comprehensive manner.
4. The basic concepts of Integration to deal with real world problems.
5. The tool of linear differential equations that are used in engineering problems.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of Total)

L : 3	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit (4 Hrs./Week = 4 Credits)

Units	Contents	No. of Lectures Allotted
I	**Unit-1: Coordinate Geometry** **Straight Lines:** Introduction, Slope of a line and angle between two lines. Various forms of equations of a line: parallel to axes, point-slope form, slope intercept form, two-point form, intercepts form. General equation of a line. Distance of a point from a line, with numerical examples. **Conic Sections:** Sections of a cone: circle, ellipse, parabola, hyperbola and pair of intersecting lines. Standard equations and simple properties of parabola, ellipse and hyperbola. Standard equation of a circle, with numerical examples.	**9L**
II	**Unit-2: Vector Algebra:** Vectors and scalars, magnitude and direction of a vector. Direction cosines/ratios of vectors. Types of vectors, position vector of a point, negative of a vector, components of a vector, addition of vectors, multiplication of a vector by a scalar, position vector of a point dividing a line segment in a given ratio. Scalar (dot) product of vectors, projection of a vector on a line. Vector (cross) product of vectors.	**9L**
III	**Unit-3: Probability:** Exhaustive events, Random experiments, trial and events, equally likely events, independent events, mutually exclusive events, compound events, favorable events, definition of probability, Axioms of probability, Addition theorem of probability with examples, Multiplication theorem of probability with illustrated examples.	**9L**
IV	**Unit-4: Integrals:** Integration of functions by substitution, Integration by parts, only simple integrals of the type to be evaluated. Basic properties of definite integrals and evaluation of definite integrals. Applications of the Integrals: Applications in finding the area between simple curves, especially lines, areas of circles/parabolas/ellipses (in	**9L**

	standard form only).	
V	**Unit-5: Differential Equations:** Definition, order and degree, general and particular solutions of a differential equation Formation of differential equations whose general solution is given. Solution of differential equations by method of separation of variables, homogeneous differential equations of first order and first degree. Solutions of linear differential equation.	**9L**

Text Books/ Reference Books:

1. NCERT Mathematics Textbooks (Class IX & X), NCERT, New Delhi
2. R.S. Aggarwal, Secondary School Mathematics, Bharti Bhawan Publishers
3. R.D. Sharma, Mathematics for Class IX & X, Dhanpat Rai Publications.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Course Learning Outcomes:

CO-1	Apply coordinate geometry concepts to analyze straight lines and conic sections, and solve problems involving equations of lines and distances from a point to a line.	**L2 & L4**
CO-2	Understand vector algebra fundamentals, including direction ratios, scalar and vector products, and apply them to geometric and physical problems.	**L3 &L4**
CO-3	Demonstrate foundational knowledge of probability theory and use the addition and multiplication theorems to compute probabilities of simple and compound events.	**L3 & L4**
CO-4	Evaluate integrals using standard techniques, including substitution and parts, and apply definite integrals to find areas under curves and between standard geometric shapes.	**L2 & L3**
CO-5	Formulate and solve basic differential equations, including separable, homogeneous, and linear types, and understand their general and particular solutions.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Engineering Mathematics-II(RTAS-121)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	2	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	3	3	2	0	0	0	0	0	1	3
CO-4	3	3	2	3	2	1	0	0	0	0	1	2
CO-5	3	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: UG(R) **Class: B.Tech. Biotechnology**			**Year: I** **Semester: II**
Credits: 4		**Category**	**Core**
Theory	**Practical**	**Course Code**	**ENBS-121**
4	**NA**	**Course Name**	**Foundational Biology Skills-II**

Course Objectives:
1. To introduce genetics, heredity, and basic molecular biology concepts.
2. To explain biological reproduction and developmental processes.
3. To give basic understanding of human physiology systems.
4. To introduce ecology and environmental biology with biotechnology relevance.
5. To help students link genetics, environment, and biology to health and innovation.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of Total)

L : 3	**T : 1**	**P : 0**	**C : 4**

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit (4 Hrs./Week = 4 Credits)

Units	Contents	No. of Lectures Allotted
I	**Plant Physiology – Basics** • Photosynthesis: light and dark reactions (overview). • Transpiration and water transport. • Mineral nutrition in plants. • Plant hormones (basic functions of auxin, gibberellin, cytokinin, ABA, ethylene).	**9L**
II	**Human Physiology – I** • Digestive system and nutrition. • Respiratory system and gas exchange. • Circulatory system: heart, blood vessels, blood composition. • Excretory system and osmoregulation.	**9L**
III	**Human Physiology – II** • Nervous system: structure of neuron, synapse, CNS & PNS (overview). • Endocrine system: major glands and hormones. • Reproductive system (overview): structure, menstrual cycle, fertilization.	**9L**
IV	**Principles of Genetics** • Mendel's laws of inheritance. • Monohybrid and dihybrid crosses. • Chromosomes and genetic material. • Genetic disorders (brief idea): thalassemia, hemophilia, Down syndrome.	**9L**

V	**Evolution and Ecology** • Origin of life: basic theories. • Darwin's theory of natural selection. • Evidence and mechanism of evolution. • Ecosystem – components and types (basic). • Food chains, food web, energy flow.	**9L**

Text Books:
Reference Books:
1. NCERT Biology Class XI & XII.
2. Solomon, Berg & Martin: *Biology*.
3. G. Rastogi – *Fundamentals of Biology*.
4. Guyton & Hall – *Human Physiology* (selective reading).
5. Campbell – *Biology* (simplified sections).

If the course is available as **Generic Elective**, then the students of following departments may opt it: NO

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course: Mathematics of Class 12

Course Learning Outcomes:

CO-1	Understand laws of inheritance and basic genetic mechanisms	**L2 & L4**
CO-2	Explain human reproductive and endocrine systems.	**L3 &L4**
CO-3	Describe physiological processes like excretion, nervous control, and hormonal action.	**L3 & L4**
CO-4	Apply concepts of ecology to understand ecosystems and biodiversity.	**L2 & L3**
CO-5	Demonstrate readiness for biotechnological applications in health and environment.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	2	0	0	0	0	2	2
CO-2	3	3	2	3	2	1	0	0	0	0	1	2
CO-3	3	3	3	3	2	0	0	0	0	0	1	3
CO-4	3	3	2	3	2	1	0	0	0	0	1	2
CO-5	3	3	3	2	2	2	0	0	0	0	2	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG (R) **Class: B.Tech. Biotechnology**			**Year: I** **Semester: II**
Credits: 4		**Category**	**VAC**
Theory	**Practical**	**Course Code**	**ENCS-121**
4	**NA**	**Course Name**	**Fundamental Concepts and Problem Solving with Python**

Course Objectives:

1. To be able to introduce core programming basics.
2. To understand a range of Object-Oriented Programming, as well as in-depth data and information processing techniques.
3. To understand data types, statement, operators, modules, list, tuple, and dictionaries.

Nature of Paper: VAC (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of Total)

L: 3	**T: 1**	**P: 0**	**C: 4**

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit (4 Hrs./Week = 4 Credits)

Units	**Contents**	**No. of Lectures Allotted**
I	**Introduction to Python Programming**: History and evolution of Python, Features and advantages, Installation and setup (Python IDEs, Jupyter Notebook, Anaconda) Basic Syntax: Python syntax and semantics, Writing and executing a Python script, Indentation and code structure **Data Types and Variables**: Basic data types (int, float, str, bool), Variable declaration and assignment, Type conversion and casting Operators and Expressions: Arithmetic, relational, logical, and bitwise operators, Operator precedence and associativity.	9L
II	**Control Structures and Functions**: Control Flow Statements: Conditional statements (if, if-else, nested if-else), Looping statements (for, while, nested loops), Control statements (break, continue, pass), Functions: Defining and calling functions, Function arguments and return values, Recursion, Lambda functions and anonymous functions, **Modules and Packages**: Importing modules and using standard libraries, Creating and using custom modules, Introduction to virtual environments.	9L
III	**Data Structures in Python**: Strings: String operations and methods, String formatting and manipulation, Lists: List operations and methods, List comprehensions, Nested lists, Tuple: Tuple operations and methods, Advantages of using tuples, **Dictionaries**: Dictionary operations and methods, Dictionary comprehensions, Nested dictionaries, Sets: Set operations and methods, Set theory operations (union, intersection, difference)	9L
IV	**Problem Solving and File Handling**: Problem Solving Techniques:	9L

	Algorithm design and pseudocode, Flowcharts, Debugging and testing, Exception handling (try, except, finally) File Handling: Reading from and writing to files, File methods and operations (open, close, read, write, append), Working with CSV and JSON files Regular Expressions: Introduction to regular expressions, Using the re module for pattern matching.	
V	**Advanced Topics and Future Technologies**: Object-Oriented Programming (OOP): Classes and objects, Inheritance, polymorphism, encapsulation, and abstraction, Magic methods and operator overloading Introduction to Data Science: Basics of NumPy and Pandas, Data analysis and manipulation, Visualization with Matplotlib and Seaborn. **Future Prospects**: Career opportunities and industry trends, Ethical considerations in technology	9L

Text Books:

1. Python Crash Course.
2. Head-First Python, 2nd edition

Reference Books:

1. Guido van Rossum, and Fred L. Drake, Jr. (Editor)
2. ISBN: 1906966141
3. Network Theory Ltd, 120 pages (Revised November 2006)

If the course is available as Generic Elective, then the students of following departments may opt it: NO

Evaluation/Assessment Methodology

Category	**Max. Marks**
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	NA
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	100
Total:	**150**

Prerequisites for the course: solid computer literacy.

Course Learning Outcomes:

CO-1	To define the structure and components of a Python program.	L2 & L3
CO-2	To learn how to build and package Python modules for reusability.	L3 & L4
CO-3	To learn how to write functions and pass arguments in Python.	L1 & L3
CO-4	To learn how to read and write files in Python.	L2 & L3
CO-5	To learn how to design object-oriented programs with Python classes.	L2 & L4

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Fundamental Concepts and Problem Solving with Python (RTCS-121)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	1	0	3	0	0	0	0	0	0	1
CO-2	2	2	2	0	3	0	0	0	0	0	1	2
CO-3	2	3	2	0	3	0	0	0	0	0	0	2
CO-4	2	3	1	0	3	0	0	0	0	0	1	2
CO-5	3	3	3	0	3	2	0	0	0	0	2	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech. Biotechnology**			**Year: I** **Semester: II**
Credits: 2		**Category**	**VAC**
Theory	**Practical**	**Course Code**	**ENCS-121P**
NA	**2**	**Course Name**	**Fundamental Concepts and Problem Solving with Python Lab**

Course Objectives:

1. Develop proficiency in writing and executing basic Python programs.
2. Implement core programming concepts including conditional statements, loops, and functions through practical tasks.
3. Enhance problem-solving skills by tackling tasks such as swapping values without a third variable.
4. Gain a strong grasp of data structures like lists, tuples, and dictionaries, and practice algorithms for operations like merging sorted lists, removing duplicates, and counting specific elements.
5. Explore advanced Python features and libraries by creating classes, utilizing random functions.

Nature of Paper: VAC (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0	**T: 0**	**P: 2**	**C: 2**

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit (4 Hrs./Week = 4 Credits)

Units	**Practical Title**
Practical-1.	Write a Python program to print "Hello, World!".
Practical-2.	Implement a calculator that can perform addition, subtraction, multiplication, and division.
Practical-3.	Determine if a given year is a leap year.
Practical-4.	Swap the values of two variables without using a third variable.
Practical-5.	Check if a given string is a palindrome.
Practical-6.	Determine the maximum of three given numbers.
Practical-7.	Check if a number is an Armstrong number.
Practical-8.	Merge two sorted lists into a single sorted list.
Practical-9.	Remove duplicate elements from a list.
Practical-10.	Python program to count positive and negative numbers in a list.
Practical-11.	Python Program to Accept the Strings Which Contains all Vowels.
Practical-12.	Write a python Programming to find Maximum record value key in dictionary
Practical-13.	Python program to find tuple which have all elements divisible by K from a list of tuple
Practical-14.	Write a Python program to create a calculator class. Include methods for basic arithmetic operations.
Practical-15.	Write a Python function to find the maximum of three numbers.
Practical-16.	Write a Python program to select a random element from a list, set, dictionary-value, and file from a directory. Use random. Choice().
Practical-17.	Write a Python program to check if a function is a user-defined function or not. Use types. Function Type, types. Lambda Type().

Reference/Text Books:

- Guido van Rossum, and Fred L. Drake, Jr. (Editor)
- ISBN: 1906966141
- Network Theory Ltd, 120 pages (Revised November 2006)

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	To Understand basic syntax of python implementation	**L2 & L3**
CO-2	To practically apply looping and conditional constructs	**L3 &L4**
CO-3	To implement program related with list data structure	**L1& L3**
CO-4	To implement various searching algorithm in python	**L2 & L3**
CO-5	To implement list, tuple, dictionary and modules	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Fundamental Concepts and Problem Solving with Python Lab (RTAS-112P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	1	2	1	3	1	1	1	1	1	1	1
CO-2	3	2	2	2	3	1	1	1	2	1	1	2
CO-3	3	3	2	2	3	1	1	1	2	1	1	2
CO-4	3	2	2	2	3	1	1	1	2	1	1	2
CO-5	3	2	2	3	3	1	1	1	2	1	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech. Biotechnology**			**Year: I** **Semester: II**
Credits: 2		**Category**	**SEC**
Theory	**Practical**	**Course Code**	**ENBT-121P**
NA	**2**	**Course Name**	**Foundational Biology Lab**

Course Objectives:

1. To develop essential practical skills in basic biology.
2. To provide hands-on experience in microscopy, cell observation, and biomolecule testing.
3. To introduce basic physiology and genetics experiments.
4. To make students familiar with plant and animal anatomy through simple dissections and observations.
5. To prepare students for future biotechnology experiments with strong biological foundations.

Nature of Paper: SEC (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0	**T: 0**	**P: 2**	**C: 2**

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit (4 Hrs./Week = 4 Credits)

Units	**Practical Title**
Practical No. 1	Introduction to microscope and its parts.
Practical No. 2	Preparation and observation of onion peel (plant cell) and cheek cell (animal cell).
Practical No. 3	Study of osmosis using potato osmometer.
Practical No. 4	Study of different types of tissues (plant and animal) using prepared slides.
Practical No. 5	Study of monocot and dicot roots/stems through sectioning.
Practical No. 6	Observation of external morphology of earthworm or cockroach (model/chart).
Practical No. 7	Qualitative tests for carbohydrates, proteins, and lipids.
Practical No. 8	Detection of starch and sugar in food samples.
Practical No. 9	Demonstration of transpiration in plants using a bell jar setup.
Practical No. 10	Study of human skeleton using model/chart.
Practical No. 11	Study of Mendelian inheritance using seeds or colored beads
Practical No. 12	Observation of different types of chromosomes using permanent slides (if available)
Practical No. 13	Identification of environmental adaptations in plants and animals (xerophytes, hydrophytes, etc)

Text Books/ Reference Books:

- NCERT Biology Lab Manual – Class 11 & 12
- Elementary Biology Practical Book – S. Chand
- Introductory Biology Lab Manual – Prakash S. Lohar

Evaluation/Assessment Methodology

Category	**Internal/External**	**Max. Marks**
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05

3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Use microscopes effectively to observe biological specimens.	**L2 & L3**
CO-2	Understand cell structure, tissue types, and plant-animal differences through hands-on observations.	**L3 &L4**
CO-3	Perform basic biomolecule identification tests.	**L1& L3**
CO-4	Explain fundamental physiological and genetic processes via simple experiments.	**L1 & L4**
CO-5	Apply foundational biology skills to future lab-based biotechnology courses.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Advance Industrial training in 'C' Lab (RSCS-121P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	1	2	1	2	2	1	0	0	0	0	2	2
CO-2	1	0	0	2	0	1	0	0	0	0	1	2
CO-3	2	1	1	2	1	0	0	0	0	0	1	2
CO-4	1	1	2	2	2	0	0	0	0	0	1	1
CO-5	2	2	2	0	1	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: UG(R) **Class: B.Tech. Biotechnology**			**Year: I** **Semester: II**
Credits: 2		**Category**	**Lab**
Theory	**Practical**	**Course Code**	**SPT-111**
0	**2**	**Course Name**	**Health and Wellness**

Course Objectives: The objectives of studying this course are

1. To develop students' physical fitness, mental well-being, and proficiency in various individual and team sports through structured participation and practice.
2. To foster qualities of discipline, teamwork, sportsmanship, and strategic thinking by engaging students in competitive and recreational games and physical activities.

Nature of Paper: Core (Practical)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of Total)

L: 0	**T:** 0	**P:** 2	**C:** 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1 Credit (4 Hrs./Week = 4 Credits)

No	Contents	No. of Lectures Allotted
1	Archery/ Athletics/ Badminton/ Basketball/ Boxing/ Carrom/ Chess/ Cricket/ Football/ Handball/l Judo/ Kabaddi/ Kho-Kho/ Martial Arts/ Powerlifting/ Table/ Tennis/ Volleyball/ Weightlifting/ Wrestling/ Yoga.	**2L**

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	15
2) Presentation/Seminar/Viva-Voce (Internal)		-
3) External Practical Assessment	External Assessment	35
4) Presentation/Seminar/Viva-Voce (External)		-
5) Practical Records		-
Total:		**50**

Prerequisites for the course: NA

Course Learning Outcomes:

CO-1	Demonstrate basic skills, rules, and techniques required for effective participation in individual sports such as athletics, archery, boxing, and martial arts.	**L3**
CO-2	Exhibit proficiency in team-based sports like football, basketball, volleyball, kabaddi, and kho-kho, with emphasis on coordination, communication, and team strategy	**L3, L4**
CO-3	Analyze and apply rules, scoring systems, and tactics in indoor games such as	**L4**

	chess, carrom, and table tennis to enhance cognitive and decision-making skills.	
CO-4	Develop and maintain physical fitness, flexibility, and endurance through regular practice and participation in strength-based and aerobic activities such as yoga, powerlifting, and athletics	**L3**
CO-5	Demonstrate sportsmanship, ethical behavior, self-discipline, and leadership qualities both during practice and competitive events.	**L3,L5**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze, L5: Evaluate, L6: Create)

CO-PO Mapping
Network Analysis Lab (RTEE-231P)

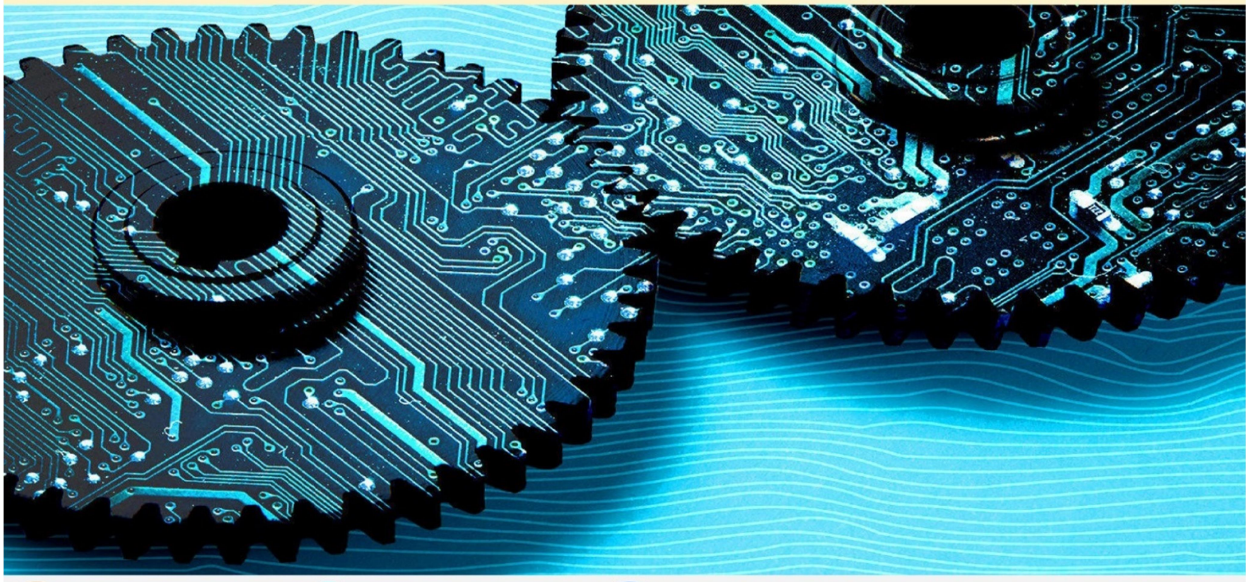
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	1	2	1	1	–	–	–	2	1	–	2
CO-2	–	1	2	–	–	–	–	–	3	2	2	2
CO-3	1	2	–	–	1	–	–	2	2	2	–	2
CO-4	–	–	–	2	–	–	2	–	1	1	–	3
CO-5	–	–	–	–	–	3	–	3	3	2	3	3

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Evaluation Scheme

Mechanical Engineering (Specialization: Production Engineering)

Evaluation Scheme – Master of Technology (Mechanical Engineering)
(Specialization: Production Engineering)
Year: I / Semester: I

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1	MSPE-111	Composite Materials	Th	Core-1	4	1	-	4	20	10	30	70	100
2	MSPE-112	Advanced Casting and Welding Technologies	Th	Core-2	4	1	-	4	20	10	30	70	100
3	MSPE-113	Advanced CAD	Th	Core-3	4	1	-	4	20	10	30	70	100
4	MSRM-111	Research Methodology	Th	Core-4	4	1	-	4	20	10	30	70	100
5	MEPE-111 / MEPE-112	Departmental Elective Course-1	Th	DSE-1	4	1	-	4	20	10	30	70	100
6	MSPE-112P	Advanced Casting and Welding Technologies Lab	P	LAB-1	0	0	2	2	10	10	20	30	50
7	NECC-111*	Industrial Visit/ Seminar/ Presentation On The Report of Visits	P	AC	0	0	0	NC*	0	25*	25*	0	25*
8.	NECC-112*	University Social Responsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**20**	**5**	**2**	**22**	**110**	**60**	**170**	**380**	**550**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non-Credit Course, SEC- Skill Enhancement Course, Th- Theory, ESE- End Semester Examination, AC- Audit course, DSE- Departmental Elective Course, LAB-Laboratory

Note: (1) NECC-111 and NECC-112 are a Non-credit course (Audit Courses) and will be evaluated on the basis of social visits/awareness campaigns/ awareness rallies during the semester. Student needs to qualify it, but the marks will not be added in total marks.
(2) A total of 4 Credits are mandatory to earn from NPTEL/Moocs/Coursera etc. during 2 years of M.Tech Program.

Discipline Specific Electives -I	1. MEPE-111 Hybrid Manufacturing 2. MEPE-112 Advance Manufacturing Processes

Evaluation Scheme – Master of Technology (Mechanical Engineering)
(Specialization: Production Engineering)
Year: I / Semester: II

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1	MSPE-121	Flexible Manufacturing System	Th	Core-5	4	1	-	4	20	10	30	70	100
2.	MSPE-122	Automation in Manufacturing	Th	Core-6	4	1	-	4	20	10	30	70	100
3	MSPE-123	Production & Operations Management	Th	Core-7	4	1	-	4	20	10	30	70	100
4	MSRE-121	Research and Publication Ethics	Th	Core-8	4	1	-	4	20	10	30	70	100
5	MEPE-121 /MEPE-122	Departmental Elective Course-2	Th	DSE-2	4	1	-	4	20	10	30	70	100
6	MSPE-124P	Production Engineering Lab	P	LAB-2	0	0	2	2	10	10	20	30	50
7	MSEC-121	Short Term Certification in Advance Technology	P	SEC-1	0	0	4	2	30	20	50	-	50
7	*NECC-121	Industrial Visit/ Seminar/ Presentation on The Report of Visits	P	AC	0	0	0	NC*	0	25*	25*	0	25*
8	*NECC-122	University Social Responsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**20**	**5**	**6**	**24**	**140**	**80**	**220**	**380**	**600**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non-Credit Course, DSE- Discipline Specific Elective, Th- Theory, ESE- End Semester Examination, AC- Audit course, DSE- Departmental Elective Course, LAB-Laboratory

*Note: NECC-121 & NECC-122 are a Non-credit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies during the semester. Student needs to qualify it but the marks will not be added in total marks

Discipline Specific Electives -II	1. MEPE-121 Advanced Industrial Engineering 2. MEPE-122 Computer Aided Manufacturing

Evaluation Scheme – Master of Technology (Mechanical Engineering)
(Specialization: Production Engineering)
Year: II / Semester: III

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1	MEPE-231 / MEPE-232	Departmental Elective Course-III	Th	DSE-3	4	1	-	4	20	10	30	70	100
2	MEPE-233 / MEPE-234	Departmental Elective Course-IV	Th	DSE-4	4	1	-	4	20	10	30	70	100
3	MSPE-231P	Seminar	P	RP-1	0	0	5	4	-	-	40	60	100
4	MSPE-232P	Synopsis of Dissertation	P	RP-2	0	0	5	4	-	-	60	90	150
5	MSEC-231	Short Term Certification in Advance Technology	P	SEC-2	0	0	4	2	30	20	50	-	50
6	*NECC-231	Industrial Visit/ Seminar/ Presentation on the report of visits	P	AC	0	0	0	NC*	0	25*	25*	0	25*
7	*NECC-232	University SocialResponsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**8**	**2**	**14**	**18**	**70**	**40**	**210**	**290**	**500**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non-Credit Course, DSE- Discipline Specific Elective, Th- Theory, ESE- End Semester Examination, AC- Audit course, DSE- Departmental Elective Course, LAB-Laboratory

*Note: (1) NECC-231 & NECC-232 are a Non-credit course (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies during the semester. Student needs to qualify it but the marks will not be added in total marks.
(2) A total of 4 Credits are mandatory to earn from NPTEL/Moocs/Coursera etc during 2 years of M.Tech Program.

Discipline Specific Elective-III	1. MEPE-231 Simulation, Modelling & Analysis 2. MEPE-232 Quality Engineering in Manufacturing
Discipline Specific Elective-IV	1. MEPE-233 Rapid Prototyping Technologies 2. MECS-234 Finite Element Techniques

Evaluation Scheme – Master of Technology (Mechanical Engineering)
(Specialization: Production Engineering)
Year: II / Semester: IV

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	MSPE-241P	Final Dissertation	P	RP-3	0	0	16	10	-	-	80	120	200
2.	MSPE-242P	Comprehensive Viva	P	RP-4	0	0	0	4	-	-	40	60	100
Total					**0**	**0**	**16**	**14**	**-**	**-**	**120**	**180**	**300**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non-Credit Course, SEC- Skill Enhancement Course, DSE- Discipline Specific Elective, Th- Theory, ESE- End Semester Examination, AECC- Ability Enhancement Compulsory Course, AC- Audit course

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Format-1

Format-1

CBCS: Statement of Credit distribution (w.e.f: Session 2024-25)								
College/School: School of Engineering & Technology **Programme: M.Tech** **Duration: 4 Semester Annual/Semester: Semester**						**Credit range: 70-80** **(Suggested by** **CBCS Committee)**		
Sem.	**Credit**	**Core Course/ Foundation Course Th (8 Core)**	**Ability Enhancement Compulsory Course (AECC)**	**Skill Enhancement Course (SEC)**	**Discipline Specific Elective (DSE)**	**Generic Elective (GE)**	**Research Project (RP)**	**Internship (INT)**
I	22	C-1 (4 Credit) C-2 (4 Credit) + P-1 (2 Credit) C-3 (4 Credit) C-4 (4 Credit)			DSE- 1 (4 Credit)			
II	24	C-5 (4 Credit) + P-2 (2 Credit) C-6 (4 Credit) C-7 (4 Credit) C-8 (4 Credit)		SEC-1 (2 Credit)	DSE- 2 (4 Credit)			
III	18			SEC-2 (2 Credit)	DSE- 3 (4 Credit) DSE- 4 (4 Credit)		Seminar (04 Credit) Synopsis of Dissertation (4 Credit)	
IV	14						Comprehensive Viva (4 Credit) Dissertation (10 Credit)	
Total Credits	**78**	8 (Th)*4(Credit) = 32 02 (Pr)*02(Credit) = 04 **Total = 36**		02 (Pr)*2 (Credit) = 04 **Total = 04**	04 (Th)*4 (Credit) = 16 **Total = 16**		04+04 = 08 04+ 10 = 14 **Total = 22**	

***Note: A total of 4 Credits are mandatory to earn from NPTEL/Moocs/Coursera etc. during 2 years of M.Tech Program.**

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Format-2

IIMTU-NEP Implementation: (w.e.f. Session 2024-25) (M.Tech. -PRODUCTION ENGINEERING) **Format-2**

Program	Year	Semester (15 weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester	Prerequisite	Elective (For other faculty)
MASTER OF TECHNOLOGY Production Engineering	FIRST YEAR	SEMESTER -I	i) Core-1 (Th. 4C)	4	5	45	Composite Materials	5		
			ii) Core-2 (Th. 4C+ P 2C)	4 2	5 2	45 30	Advanced Casting and Welding Technologies Advanced Casting and Welding Technologies Lab	5		
			iii) Core-3	4 2	5 2	45 30	Advanced CAD	5		
			iv) Core-4 (Th. 4C)	4	4	45	Research Methodology	5		
			v) DSE-1 (Th.4C)	4	5	45	1. Hybrid Manufacturing 2. Advance Manufacturing Processes	5		
		SEMESTER – II	i) Core-5 (Th. 4C)	4	4	45	Flexible Manufacturing System	5		
			i) Core-6 (Th. 4 C + P 2C)	4 2	5 3	45 30	Automation in Manufacturing Production Engineering Lab	5		
			ii) Core-7 (Th. 4C)	4	4	45	Production & Operations Management	5		
			iv) Core-8 (Th. 4C)	4	4	45	Research and Publication Ethics	5		
			v) DSE-2 (Th.4C)	4	5	45	1.Advanced Industrial Engineering 2.Computer Aided Manufacturing	5		
			vi) SEC-1 (P 2C)	2	3	30	Certification course (in advance technology on concern branch)			

Programme	Year	Semester (15 weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester)	Prerequisite	Elective (For other faculty)
Master of Technology Production Engineering	Second Year	Semester -III	i) DSE-3 (Th.4C)	4	5	45	1.Simulation, Modelling & Analysis 2.Quality Engineering in Manufacturing	5		
			ii) DSE-4 (Th.4C)	4	5	45	1.Rapid Prototyping Technologies 2.Finite Element Techniques	5		
			iii) SEC- 2 (P 2C)	2	4	30	Certification course (in advance technology on concern branch)	-		
			iv) RP-1 (P 4C)	4	5	45	Seminar	-		
			v) RP- 2 (P 4C)	4	5	45	Synopsis of Dissertation	-		
		Semester -IV	i) RP- 3 (P 10C)	10	16	60	Dissertation (Final)	-		
			ii) RP- 4 (P 4C)	4	--	--	Comprehensive Viva	-		

Programme Outcomes:
PO_1 –PO_{12} **[ANNEXTURE-1]**

Programme Specific Outcomes:
PSO_1 –PSO_2 **[ANNEXTURE-2]**

***Total of 4 credit are mandatory to earn from NPTEL/MOOCS/ COURSE ERA etc during two years of M.Tech Program**

ANNEXURE- I

Programme Outcome:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and Research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

ANNEXURE- II

Programme Specific Outcome:

PSO1: Apply advanced knowledge of manufacturing and automation to improve production systems. Enhance productivity through modern tools and integrated technologies.

PSO2: Design and optimize production processes using CAD/CAM and simulation tools. Ensure cost-effective, sustainable, and high-quality manufacturing solutions.

PSO3: Engage in research and innovation in emerging manufacturing technologies. Develop solutions in areas like additive manufacturing and industrial robotics.

Evaluation Scheme

Mechanical Engineering (Specialization: Power Electronics and Drive)
(Effective from the Session: 2024-25)

Evaluation Scheme – Master of Technology (Power Electronics and Drive)
Year: I / Semester: I

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+ TA	ESE	Total
1.	MSPED-111	Modelling and Analysis of Electrical Machines	Th	Core-1	4	1	-	4	20	10	30	70	100
2.	MSPED-112	Power Converter-I	Th	Core -2	4	1	-	4	20	10	30	70	100
3.	MSPED-113	Industrial Electrical Drives	Th	Core-3	4	1	-	4	20	10	30	70	100
4.	MSRM-111	Research Methodology	Th	Core -4	4	1	-	4	20	10	30	70	100
5.	MEPED-114- MEPED - 116	Departmental Elective-I	Th	DSE-1	4	1	-	4	20	10	30	70	100
6.	MSPED-113P	Electrical Drives Lab	P	LAB-1	0	0	2	2	10	10	20	30	50
7.	NECC-111*	Industrial Visit/ Seminar/ Presentation On The Report Of Visits	P	AC	0	0	0	NC*	0	25*	25*	0	25*
8.	NECC-112*	University Social Responsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**20**	**5**	**2**	**22**	**110**	**60**	**170**	**380**	**550**

TH- Theory paper, P-Practical, L-Lecture, T-Tutorials, C-Credit, AECC – Ability Enhancement Compulsory Course, AC – Audit Courses, NC*-No Credit Course, CT – Class Test (Sessional Examinations), TA – Teacher's Assessment, ESE – End Semester Examinations.

Engineering Courses (Core)	Modelling and Analysis of Electrical Machines, Industrial Electric Drives, Research Methodology, Power Converter-I, Electric Drives Lab
Discipline-Specific Electives I	1. MEPED-114 – Advanced Control Systems 2. MEPED-115 –Digital Signal Processing 3. MEPED-116- Neural Networks & Fuzzy logic

Evaluation Scheme – Master of Technology (Power Electronics and Drive)
Year: I / Semester: II

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+ TA	ESE	Total
1.	MSPED-121	Power Electronics Applications in Power Systems	Th	Core-1	4	1	-	4	20	10	30	70	100
2.	MSPED -122	Power Converter-II	Th	Core -2	4	1	-	4	20	10	30	70	100
3.	MSPED -123	Power Semiconductor Devices	Th	Core-3	4	1	-	4	20	10	30	70	100
4.	MSRE-121	Research Publication & Ethics	Th	Core -4	4	1	-	4	20	10	30	70	100
5.	MEPED-124-MEPED-126	Departmental Elective-II	Th	DSE-2	4	1	-	4	20	10	30	70	100
6.	MSPED -122P	Power Converter Lab	P	LAB-1	0	0	2	2	10	10	20	30	50
7.	MSEC-121	Certification course (in advance technology on concern branch)	P	SEC-1	0	0	4	2	30	20	50	-	50
8.	*NECC-121	Industrial Visit/ Seminar/ Presentation On The Report Of Visits	P	AC	0	0	0	NC*	0	25*	25*	0	25*
9.	*NECC-122	University Social Responsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**20**	**5**	**6**	**24**	**140**	**80**	**220**	**380**	**600**

TH- Theory paper, P-Practical, L-Lecture, T-Tutorials, C-Credit, AECC – Ability Enhancement Compulsory Course, AC – Audit Courses, NC*-No Credit Course, CT – Class Test (Sessional Examinations), TA – Teacher's Assessment, ESE – End Semester Examinations.

Engineering Courses (Core)	Power Electronics Applications in Power Systems, Power Converter-II, Advanced Semiconductor Devices, Research Publication & Ethics, Power Converter Lab
Skill Enhancement Courses-SEC	MSEC-121-Certification course (in advance technology on concern branch)
Discipline Specific Electives II	1. MEPED-124 – Smart Grid Technology 2. MEPED-125 –Non-Conventional Energy Sources & Energy Converters 3. MEPED-126- Digital Control Systems

Evaluation Scheme – Master of Technology (Power Electronics and Drive)
Year: II / Semester: III

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	MEPED-231-MEPED-233	Departmental Elective-III	Th	DSE-3	4	1	-	4	20	10	30	70	100
2.	MEPED-234-MEPED-236	Departmental Elective-IV	Th	DSE-4	4	1	-	4	20	10	30	70	100
3.	MSPED-231P	Seminar	P	RP-1	0	0	5	4			40	60	100
4.	MSPED-232P	Synopsis/ Dissertation Proposal	P	RP-2	0	0	5	4			60	90	150
5.	MSEC-231	Certification course (in advance technology on concern branch)	P	SEC-2	0	0	4	2	30	20	50	-	50
6.	*NECC-231	Industrial Visit/ Seminar/ Presentation on the report of visits	P	AC	0	0	0	NC*	0	25*	25*	0	25*
7.	*NECC-232	University Social Responsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**8**	**2**	**14**	**18**	**70**	**40**	**210**	**290**	**500**

Th- Theory, L-Lecture, T-Tutorials, P-Practical (Labs), C-Credit, CT-Class Test (Sessional), TA-Teacher's Assessment (Attendance, Assignments, Tutorials, Class Tests, Quiz etc.),ESE-End Semester Examinations, NC*-Non-Credit Course, AC-Audit Course, SEC – Skill Enhancement Course.

Skill Enhancement Courses-SEC	MSEC-231- Certification course (in advance technology on concern branch)
Discipline Specific Electives III	1. MEPED-231 - Facts 2. MEPED-232 –HVDC Transmission Systems 3. MEPED-233- Industrial Electronics
Discipline Specific Electives IV	1. MEPED-234 – Mechatronic Systems 2. MEPED-235 –Power Quality 3. MEPED-236- Optimization Techniques
Research Project	Synopsis/ Dissertation Proposal

Evaluation Scheme – Evaluation Scheme – Master of Technology (Power Electronics and Drive)
Year: II / Semester: IV

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	MSPED-241P	Dissertation (Final)	P	RP-3	0	0	16	10			80	120	200
2.	MSPED -242P	Comprehensive Viva	P	RP-4	0	0	0	4			40	60	100
Total					**0**	**0**	**16**	**14**			**120**	**180**	**300**

Th- Theory, L-Lecture, T-Tutorials, P-Practical (Labs), C-Credit, CT-Class Test (Sessional), TA-Teacher's Assessment (Attendance, Assignments, Tutorials, Class Tests, Quiz etc.),ESE-End Semester Examinations, NC*-Non-Credit Course, AC-Audit Course,

Research Project	Comprehensive Viva, Dissertation (Final)

Format-3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Composite Materials**
Course Code: MSPE-111	**Title: Composite Materials**

Course Objectives:

1. Understand the basic concepts, classifications, and characteristics of composite materials and their applications.
2. Analyze the effects of reinforcement properties on composite performance.
3. Learn various manufacturing methods for metal, ceramic, and polymer matrix composites.
4. Evaluate and design for composite strength using different failure criteria and stress analysis methods.
5. Explore the environmental and sustainability aspects of composite materials, including recycling and lifecycle analysis.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION:** Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.	9L
II	**REINFORCEMENTS:** Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.	9L
III	**Manufacturing of Metal Matrix Composites:** Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications.	9L

	Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.	
IV	**Manufacturing of Polymer Matrix Composites:** Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.	**9L**
V	**Strength:** Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.	**9L**

Reference/ Text Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
3. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.
4. Composite Materials Science and Applications – Deborah D.L. Chung.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the classifications, characteristics, and applications of various composite materials.	**L2 & L3**
CO-2	Analyze the functional roles of reinforcement and matrix in composites and their effects on overall performance.	**L3 &L4**
CO-3	Prepare and process different types of reinforcements such as glass fibers, carbon fibers, Kevlar fibers, and boron fibers.	**L1& L3**
CO-4	Apply the rule of mixtures and understand mechanical behavior under isostrain and isostress conditions.	**L2 & L3**
CO-5	Utilize various manufacturing techniques for metal matrix, ceramic matrix, and polymer matrix composites.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)												
CO-PO Mapping Composite Materials (MSPE-111)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	1	2	0	0	0	0	0	3
CO-2	3	3	3	2	1	2	0	0	0	0	0	2
CO-3	3	2	2	2	2	2	0	0	0	0	0	1
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	3	0	0	0	0	0	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Advanced Casting and Welding Technologies**
Course Code: MSPE-112	**Title: Advanced Casting and Welding Technologies**

Course Objectives:

1. Study of various metal casting and joining processes
2. Control of parameters for sound casting and welding
3. Thermal and fluid transfer mechanism during these processes
4. Metallurgical effects of casting and joining
5. Analyze defects in casting and welding processes and develop strategies for their prevention and remediation.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Laser Beam Welding:** Types of lasers, equipment, power calculation, applications, dual laser beam welding, use of fiber optics in LBW. **Friction Stir Welding**; Details of process and process parameters, specific applications. **Electron Beam Welding**; The interaction of electron beam with matter, mode of heat generation, mode of energy losses, details of the equipment, product design for EBW, case studies. **Ultrasonic Welding**; Propagation of ultrasonic waves in matter, mode of joint formation, joint types and design of product for ultrasonic welding, details of equipment and case studies cutting and gauging, flame cutting plasma arc welding, laser assisted cutting.	**9L**
II	**Heat flow in Welding:** Significance, theory of heat flow cooling rate determination, selection of welding parameters based on heat flow analysis,	**9L**

	residual stresses and distortion. Joint design, analysis of fracture and fatigue of welded joints. Automated welding systems.	
III	Investment casting, shell moulding, squeeze casting, vacuum casting, counter-gravity flow-pressure casting, directional and monocrystal solidification, squeeze casting, semisolid metal casting, rheocasting.	**9L**
IV	Solidification Gating and Risering, Nucleation and grain growth, solidification of pure metals, short and long freezing range alloys. Gating and risering desing calculations, Fluidity and its measurement.	**9L**
V	**CAE of Welding and Casting:** Design of weldment, application of finite element method in welding – determination of distortion in weldments, modeling of temperature distribution – case studies. Design for casting, application of finite element method in casting- determination of hot spots, location of turbulence and other defects, modeling of flow in molds, modeling of heat transfer in castings- case studies.	**9L**

Reference/ Text Books:

1. Ravi B, "Metal Casting: Computer Aided Design and Analysis" Prentice Hall, 2005.
2. Richard L Little, "Welding and Welding Technology" Tata McGraw Hill, 2004.
3. John Campbell, "Casting Practice" Elsevier Science Publishing C0., 2004.
4. Larry Jeffus, "Welding Principles and Applications" Delmar Publishers, 2004.
5. John Campbell "Casting Butterworth Heinemann, 2003.
6. Klas Weman,: Welding Processes Handbook", 2003.
7. Howard B Cary, "Modern Welding Technology" Prentice Hall, 2002.
8. Larry Jeffus, "Welding for Collision Repair", Delmar Publishers, 1999.
9. ASM Hand Book "Casting", ASM International 1998.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Discriminate the knowledge of principles, operations and applications of different casting and welding processes.	**L2 & L3**
CO-2	Analyze the effects of process parameters on the quality of cast and weld products.	**L3 &L4**
CO-3	Select the NDT techniques for the evaluation of cast and weld components.	**L1& L3**
CO-4	Apply the knowledge of welding in Heavy Engineering and nuclear industries.	**L2 & L3**

CO-5	Evaluate and mitigate defects in casting and welding processes through appropriate techniques and process adjustments.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Advanced welding & Casting Technology (MSPE-112)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	3	1	3	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	1
CO-3	3	2	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	1	2	1	1	0	0	0	0	0	3
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Advanced CAD**
Course Code: MSPE-113	**Title: Advanced CAD**

Course Objectives:

1. To impart fundamental knowledge to students in the latest technological topics on Computer Aided Design to broaden and deepen their capabilities.
2. To impart fundamental knowledge on Finite Element Methods to analyze the real life design in the industry.
3. To inculcate the ability to work with inter-disciplinary groups in professional, industry and research organizations.
4. To design and validate technological solutions to defined problems and communicate clearly and effectively for the practical application of their work.
5. To foster a continuous learning attitude to adapt to evolving technologies and methodologies in Computer Aided Design and Finite Element Analysis.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION TO CAD:** Definition of Cad, Design Criteria, Design Tool, Cad Tools, Design Analysis, Functional Areas CAD, and CAD Softwares and their efficient use. **GEOMETRIC MODELLING**: Interpolation and Extrapolation of Curves, Properties of Splines, Wire Frame Modeling: Wire Frame Entities and Modeling. **SYNTHETIC CURVES:** Hermite, Bezier and B-spline Curves and their properties.	**9L**
II	**SURFACE MODELING:** Analytic and Synthetic surfaces. Planar rule, surface of revolution, Tabulated cylinder. **SYNTHETIC SURFACE:** Bi cubic, Bezier, B-spline and NURBS	**9L**

	Surfaces.	
III	**ADVANCED SURFACES:** Coons, Blending, Sculptured Surfaces. Surface Manipulation, Displaying Segmentation, Trimming, intersection. **TRANSFORMATIONS:** 2-D and 3-D Transformations, Homogeneous Transformation and Concatenation.	**9L**
IV	**3-D MODELLING:** B-Rep, C-Rep, Cell Decomposition, Spatial occupancy and Enumeration, Primitive Instancing. **GRAPHICS STANDARDS:** IGES, STEP, ACIS and DXF. **DESIGN APPLICATIONS:** Mechanical Tolerances, Mass Properties, Mechanical Assembly, Finite Element Modeling (Mesh).	**9L**
V	**COLLOBORATIVE-ENGINEERING:** Collaborative Design, Mockup Design, Morphology, Behavioural and Feature Based Modeling and Analysis, Sensitivity analysis, Conceptual, Bottom up and Top down Design Approach.	**9L**

Reference/ Text Books:

1. Mathematical Elements For Computer Graphics – David Rosers, 2nd Edition Tata Mc Graw Hill 2002.
2. CAD/CAM, Principles and Applications, 3rd Edition Tata Mc Graw Hill 2010.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the basic fundamentals of computer aided design and computer devices.	**L2 & L3**
CO-2	To learn 2D & 3D transformations of the basic entities like line, circle, etc. and coordinate system	**L3 &L4**
CO-3	To understand the different geometric modeling techniques like solid modeling, surface modeling, and to visualize how the components look like before its manufacturing or fabrication.	**L1& L3**
CO-4	To learn at least one high end design software	**L2 & L3**
CO-5	To learn the design analysis through Finite Element Method.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Advanced CAD (MSPE-113)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	3	2	2	2	0	0	0	0	0	3
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	2	2	1	1	3	0	0	0	0	0	3
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Research Methodology**
Course Code: MSRM-111	**Title: Research Methodology**

Course Objectives:
1. To introduce with Research Methodology and its importance.
2. To study the concept of research design.
3. To determination of data collection, analysis, and their interpretation.
4. To know the types of research reports and plagiarism.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction;** Meaning of Research; Objectives; Types; Approaches Adopted in research; Significance; Methodology; different Criteria of Research; and Challenges Faced by Researchers in India; Definition and selection of the Research Problem; Importance of literature review.	**9L**
II	**Research Design:** Meaning; Methods of research design; Important Concepts Relating to Research Design, Types; and Basic Principles of Designs.	**9L**
III	**Design of Sampling:** Introduction; Sampling techniques; Errors; Sample Survey; Types of Sampling. **Data Collection:** Types of Data, Classifications of Measurement Scales, Error in Measurement Tools, Scaling, Scaling Technics, Deciding the Scale; Collection of data; Methods of Data Collection.	**9L**
IV	**Testing of Hypotheses:** Basic Concepts; Hypothesis Testing; Statistics and Critical Region; Procedure for Hypothesis Testing, Limitations; Interpretation of results.	**9L**
V	**Interpretation and Report Writing:** Introduction; Methods of Interpretation; Precaution; Significance of Report Writing, Different Steps	**9L**

	in Writing Report, Layout of the Research Report, Types of Reports, Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and referencing styles, Research Journals, Indexing and citation of Journals, Intellectual property, Plagiarism.	

Reference/ Text Books:

1. C. R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques, New Age International publishers, Third Edition.
2. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition, SAGE, 2005.
3. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition.
4. Creswell, John W. Research design: Qualitative, quantitative, and mixed methods approach. Sage publications, 2013.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Discuss the importance of the research methodology and its technique.	**L2 & L3**
CO-2	Understand the importance of literature review in research.	**L3 &L4**
CO-3	Use different methods of research design and data collections.	**L1& L3**
CO-4	Understand the several parametric tests of hypotheses.	**L2 & L3**
CO-5	To evaluate the problems and set hypotheses.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Research Methodology (MSRM-111)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Hybrid Manufacturing**
Course Code: MEPE-111	**Title: Hybrid Manufacturing**

Course Objectives:

1. Introduce the concepts, challenges, and feasibility of hybrid machining processes.
2. Understand the principles, mechanisms, advantages, disadvantages and applications of electrochemical and chemical machining processes.
3. Explore hybrid machining processes involving mechanical and thermal interactions, such as EDM with ultrasonic assistance and abrasive hybrid machining.
4. Examine the integration of multiple machining techniques to enhance process efficiency and product quality.
5. Analyze case studies and practical applications to demonstrate the benefits and limitations of hybrid machining processes.

Nature of Paper: Theory (DSE)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Hybrid Machining Processes:** Introduction, Needs of Hybridization of the machining process, Challenges and feasibility of process.	**9L**
II	**Chemical and Electro-chemical Type Material Removal Processes:** Principle, working advantages, disadvantages and applications of Electrochemical, Chemical machining, Economy aspects of ECM, Electro-chemical deburring and honing. Mechanical and Thermal interaction, Electrical Hybrid Machining Processes(ECDM, ECAM), Electrical Discharge Machining with Ultrasonic Assistance (EDMUS)	**9L**
III	**Abrasive Hybrid Machining** (AHM) Processes, Abrasive Electrochemical Machining processes, Electrochemical assistance of Ultrasonic Machining (USMEC), Abrasive Electrical Discharge Grinding	**9L**

IV	**Laser Assisted Micromachining:** Laser-assisted etching (LAE), Electrochemical Micromaching with Laser Assistance (ECML),	**9L**
V	**Methods of Metal Deposition**: Thermal Spray Coating: Vapor Deposition Chemical Vapor Deposition	**9L**

Reference/ Text Books:

1. Advance Machining Processes V.K. Jain New Age
2. Modern Machining Processes P.C. Pandey New Age
3. Manufacturing Processes Degarmo -
4. Manufacturing Processes Kalpakjian Tata McGraw-Hill International
5. Amitabh Gosh and A.K. Mallik, "Manufacturing Science", Affiliated East-West Press Pvt. Ltd., 1985.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the concepts and needs for hybridization of machining processes, along with the associated challenges and feasibility.	**L2 & L3**
CO-2	Explain the principles, working mechanisms, advantages, and disadvantages of electrochemical and chemical machining processes, including their economic aspects.	**L3 &L4**
CO-3	Analyze the interactions between mechanical, thermal, and electrical processes in hybrid machining, and apply techniques such as EDM with ultrasonic assistance and abrasive hybrid machining.	**L1& L3**
CO-4	Implement laser-assisted micromachining techniques, including laser-assisted etching and electrochemical micromachining with laser assistance.	**L2 & L3**
CO-5	Apply various metal deposition methods, such as thermal spray coating and chemical vapor deposition, in manufacturing processes.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1: Remember, L2: Understand, L3: Apply, L4 : Analyze)

CO-PO Mapping Hybrid Manufacturing (MEPE-111)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Advance Manufacturing Processes**
Course Code: MEPE-112	**Title: Advance Manufacturing Processes**

Course Objectives:

1. Introduce the principles, equipment, and applications of various non-traditional machining processes.
2. Analyze the mechanics, models, and parametric influences on process capabilities and material removal rates.
3. Understand the principles and performance characterization of laser beam, plasma arc, and electron beam machining.
4. Examine the principles, equipment, and applications of electrochemical machining and processing of ceramics.
5. Explore advanced manufacturing techniques such as e-manufacturing, nanotechnology, micromachining, and high-speed machining.

Nature of Paper: Theory (DSE)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Surface treatment:** Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating, Electro forming, Chemical vapour deposition, thermal spraying, lon implantation, diffusion coating, Diamond coating and cladding.	9L
II	**Non-Traditional Machining:** Introduction, need AJM, Parametric Analysis, Process capabilities, USM-Mechanics of Cutting, models, Parametric Analysis, WJM – principles, equipment, generators, analysis of R-C circuits, MRR, Surface finish, WEDM.	9L
III	**Laser Beam Machining** – Principles of working, equipment, Material removal rate, Process parameters, performance characterization, applications.	9L

	Plasma Arc Machining – Principles of working, equipment, Material removal rate, Process Parameters, performance characterization, applications **Electron Beam Machining** – Principle of working equipment, Material removal rate, Process performance characterization, applications **Electro Chemical Machining** – Principle of working, equipment, Material removal rate, Process parameters, performance characterization, applications	
IV	**Processing of ceramics:** Applications characteristics, classification Processing of particulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.	**9L**
V	**Fabrication of Microelectronics devices:** Crystal growth and wafer preparation, Film deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in microelectronics, surface mount technology, Integrated circuits economics. E-Manufacturing, nanotechnology, and micromachining, High speed Machining	**9L**

Reference/ Text Books:

1. Manufacturing Engineering and Technology, Kalpakijian, Adisson Wesley 1995
2. Process and Materials of Manufacturing RA Lindburg 4th edition PHI 1990
3. Foundation of MEMS/Chang Liu/ Pearson, 2012
4. Advanced Machining Processes VKJin, Allied Publications.
5. Introduction to Manufacturing Processes, John A Schey, Mc Graw Hill.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the principles and applications of non-traditional machining processes.	**L2 & L3**
CO-2	Analyze the parametric influences and performance characteristics of various machining techniques.	**L3 &L2**
CO-3	Evaluate the material removal rates and process parameters for laser, plasma arc, and electron beam machining.	**L1& L3**
CO-4	Apply knowledge of electrochemical machining and ceramic processing in	**L2 & L4**

	practical scenarios.	
CO-5	Explore advanced manufacturing technologies, including e-manufacturing, nanotechnology, and high-speed machining.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1: Remember, L2: Understand, L3: Apply, L4 : Analyze)

CO-PO Mapping Hybrid Manufacturing (MEPE-111)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: I**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Advanced Casting and Welding Technologies Lab**
Course Code: MSPE-112P	**Title: Advanced Casting and Welding Technologies Lab**

Course Objectives:

1. Study the principles, operations, and applications of different casting and welding processes.
2. Analyze the effects of process parameters on the quality of cast and weld products.
3. Investigate the thermal and fluid transfer mechanisms during welding and casting.
4. Explore the metallurgical effects of casting and welding processes.
5. Develop skills in non-destructive testing (NDT) techniques for evaluating cast and weld components.

Nature of Paper: Practical

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 2 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical -1	Study of arc characteristics in simulated MMA welding; arc gap-arc voltage relationship; recording of voltage oscillograms and its study.
Practical -2	Study of heat flow and temperature distribution in welding
Practical -3	Study of characteristics of TIG/MIG welding
Practical -4	Ultrasonic/dye penetrant inspection or computer simulation of welding heat flow/analysis of arcvoltage pattern.
Practical -5	Practice on CAD of gating and risering
Practical -6	Experiment to determine the effect of moulding variables in sand moulds
Practical -7	To determine the effect of mould additive on the properties of castings
Practical -8	To determine the characteristics of base sands.

Reference/Text Books:

1. *Welding Technology and Design" by V. M. Radhakrishnan*
2. *"Principles of Metal Casting" by Richard W. Heine, Carl R. Loper Jr., and Philip C. Rosenthal*
3. *"Welding: Principles and Applications" by Larry Jeffus*
4. *"Foundry Technology" by Peter Beeley*
5. *"Metallurgy and Mechanics of Welding" by Regis Blondeau*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Discriminate the knowledge of principles, operations, and applications of different casting and welding processes.	**L2 & L3**
CO-2	Analyze the effects of process parameters on the quality of cast and weld products.	**L3 &L4**
CO-3	Select the NDT techniques for the evaluation of cast and weld components.	**L1& L3**
CO-4	Apply the knowledge of welding in heavy engineering and nuclear industries.	**L2 & L3**
CO-5	Evaluate and mitigate defects in casting and welding processes through appropriate techniques and process adjustments.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Advanced Casting and Welding Technologies Lab (MSPE-112P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Flexible Manufacturing System**
Course Code: MSPE-121	**Title: Flexible Manufacturing System**

Course Objectives:

1. To introduce students to the definition, classification, and need for flexibility in manufacturing systems, and to understand the types of flexibilities and their measurement.
2. To provide knowledge on the factors driving the growth of FMS, its types, applications, and economic justification, along with the functional requirements and equipment used in FMS.
3. To explore the concepts, advantages, and methodologies of group technology, including part family formation, coding, classification, and cell formation methods.
4. To address design, planning, and operational problems in FMS, and to explore methodologies for solving these problems.
5. To impart an understanding of the integration of computer-aided design (CAD), computer-aided manufacturing (CAM), and other advanced technologies in flexible manufacturing systems (FMS).

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** FMS definition and classification of manufacturing systems, Automated production cycle, Need of flexibility, Concept of flexibility, Types of flexibilities and its measurement.	**9L**
II	**FMS Equipment:** Why FMS, Factors responsible for the growth of FMS, FMS types and applications, Economic justification for FMS, Functional requirements for FMS equipments, FMS processing and QA equipment, e.g., turning and machining centers, Co-ordinate measuring machines, Cleaning and deburring machines, FMS system support equipment, Automated material handling and storage equipment, cutting tool and tool management, Work holding considerations, Fixture considerations in FMS environment.	**9L**

III	**Group Technology:** GT concepts, Advantages of GT, Part family formation-coding and classification systems; Part machine group analysis, Methods for cell formation, Use of different algorithms, mathematical programming and graph theoretic model approach for part grouping, Cellular vs FMS production. FMS related problem and Solution **Methodology:** FMS design problems: Part assignment, Machine selection, Storage system selection, Selection of pallets and fixtures, Selection of computer hardware and software, designing for layout integration of machine storage, Material handling System and computer system, Communication networks.	**9L**
IV	**FMS planning problems:** Strategic planning, Part type selection, Machine grouping, production ratio and resource allocation, Machine loading problems.	**9L**
V	**Operational & Control problems:** Part scheduling, Machines robots & AGVS, Process monitoring & control. **FMS Implementation:** Objectives, acceptance testing, Performance goals and expectation maintenance concerns.	**9L**

Reference/ Text Books:

1. Automation, Production System & Computer Integrated Manufacturing Groover Englewood
2. Design and Operation of SMS Rankey IFS
3. Flexible Manufacturing System Wernecks Spring-Verlag
4. FMS in Practice Bonctto Northox Ford
5. Flexible Manufacturing Cells and systems W.W. Luggen Prentice Hall India
6. Performance Modelling of Automated Manufacturing Systems Vishwanathan S.D. Sharma/ Operations Research

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the definition, classification, and necessity of flexibility in manufacturing systems, including the types and measurement of flexibilities.	**L2 & L3**
CO-2	Identify the factors responsible for the growth of FMS, its types, applications, and economic justification, along with the functional requirements for FMS equipment.	**L3 &L4**
CO-3	Apply group technology concepts to form part families, use coding and	**L1& L3**

	classification systems, and employ various methods for cell formation and part grouping.	
CO-4	Analyze and solve FMS design, planning, and operational problems, including part assignment, machine selection, storage system selection, and scheduling.	**L2 & L3**
CO-5	Implement FMS with a focus on strategic planning, production ratios, resource allocation, process monitoring, control, and maintenance.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Flexible Manufacturing System (MSPE-121)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Automation in Manufacturing**
Course Code: MSPE-122	**Title: Automation in Manufacturing**

Course Objectives:
1. Describe the basic concepts of automation in manufacturing systems.
2. Acquire the fundamental concepts of automated flow lines and their analysis.
3. Classify automated material handling, automated storage and retrieval systems.
4. Illustrate adaptive control systems and automated inspection methods
5. Understand the integration and application of robotics in manufacturing automation.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Automation:** Automation in Production Systems- Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Principles and Strategies. Manufacturing operations, Production Concepts and Mathematical Models. Costs of Manufacturing Operations, Basic Elements of an Automated Systems, Advanced Automation Functions, Levels of automation.	**9L**
II	**Introduction to Material Handling**, Overview of Material Handling Equipment, Considerations in Material Handling System Design, The 10 Principles of Material Handling. Material Transport Systems, Automated Guided Vehicle Systems, Monorails and other Rail Guided Vehicles, Conveyor Systems, Analysis of Material Transport Systems. Storage Systems, Storage System Performance, Storage Location Strategies, Conventional Storage Methods and Equipment, Automated Storage Systems, Engineering Analysis of Storage Systems. Automatic data capture-overview of Automatic identification methods, bar code	**9L**

	technology, other ADC technologies.	
III	**Manual Assembly Lines** - Fundamentals of Manual Assembly Lines, Alternative Assembly Systems, Design for Assembly, Analysis of Single Model Assembly Lines, Line balancing problem, largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights Method, Mixed Model Assembly Lines, Considerations in assembly line design.	**9L**
IV	**Transfer lines, Fundamentals of Automated Production Lines**, Storage Buffers, and Applications of Automated Production Lines. Analysis of Transfer Lines with no Internal Storage, Analysis of Transfer lines with Storage Buffers.	**9L**
V	**Automated Assembly Systems, Fundamentals of Automated Assembly Systems**, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems - Parts Delivery System at Work Stations, Multi- Station Assembly Machines, Single Station Assembly Machines, Partial Automation.	**9L**

Reference/ Text Books:

1. CAD CAM: Principles, Practice and Manufacturing Management / Chris Mc Mohan, Jimmie Browne / Pearson edu. (LPE)
2. Automation, Buckinghsm W, Haper & Row Publishers, New York, 1961
3. Automation for Productivity, Luke H.D, John Wiley & Sons, New York, 1972.
4. Automation, Production systems and computer integrated manufacturing, Mikel P. Groover/Pearson Education.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Illustrate the basic concepts of automation in machine tools.	**L2 & L3**
CO-2	Analyze various automated flow lines, Explain assembly systems and line balancing methods.	**L3 &L4**
CO-3	Describe the importance of automated material handling and storage systems.	**L1& L3**
CO-4	Interpret the importance of adaptive control systems, automated inspection systems.	**L2 & L3**
CO-5	Understand and apply robotics in manufacturing automation and their impact on production efficiency.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Automation in Manufacturing (MSPE-122)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Production & Operations Management**
Course Code: MSPE-123	**Title: Production & Operations Management**

Course Objectives:

1. To develop an understanding of how the operations, have strategic importance and can provide a competitive advantage in the workplace.
2. To understand the relationship between operations and other business functions.
3. To understand techniques of location and facility planning; line balancing; job designing; and capacity plan in operations management.
4. To develop skills in analyzing and improving operational processes for increased efficiency and effectiveness.
5. To apply quantitative and qualitative methods for decision-making in operations management, including forecasting, inventory control, and quality management.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Operation Management** – Definition – Objectives – Types of production systems – historical development of operations management – Current issues in operation management. **Product design** – Requirements of good product design – product development – approaches – concepts in product development – standardization – simplification – Speed to market – Introduction to concurrent engineering.	**9L**
II	**Alue engineering** – objective – types of values – function & cost – product life cycle- steps in value engineering – methodology in value engineers – FAST Diagram – Matrix Method. **Location** – Facility location and layout – Factors considerations in Plant location- Comparative Study of rural and urban sites – Methods of	**9L**

	selection plant layout – objective of good layout – Principles – Types of layout – line balancing.	
III	**Aggregate Planning** – definition – Different Strategies – Various models of Aggregate Planning – Transportation and graphical models. **Advance inventory control systems push systems** – Material Requirement – Terminology – types of demands – inputs to MRP-techniques of MRP – Lot sizing methods – benefits and drawbacks of MRP –Manufacturing Resources Planning (MRP –II), Pull systems – Vs Push system – Just in time (JIT) philosophy Kanban System – Calculation of number of Kanbans Requirements for implementation JIT – JIT Production process – benefits of JIT.	**9L**
IV	**Scheduling** – Policies – Types of scheduling – Forward and Backward Scheduling – Grant Charts – Flow shop Scheduling – n jobs and 2 machines, n jobs and 3 machines – job shop Scheduling – 2 jobs and n machines – Line of Balance.	**9L**
V	**Project Management** – Programming Evaluation Review Techniques (PERT) – three times estimation – critical path – probability of completion of project – critical path method – crashing of simple nature.	**9L**

Reference/ Text Books:

1. Operations Management Theory and Problems - Joseph G. Monks.
2. Production Systems Management - James I. Riggs.
3. Production and Operations Management - Chary.
4. Operations Management - Chase
5. Production and Operation Management - Panner Selvam
6. Production and Operation Analysis – Nahima
7. "Operations Management " by E.S. Buffs

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Identify the elements of operations management and various transformation processes to enhance productivity and competitiveness.	**L2 & L3**
CO-2	Analyze and evaluate various facility alternatives and their capacity decisions, develop a balanced line of production & scheduling and sequencing techniques in	**L3 &L4**

	operation environments.	
CO-3	Develop aggregate capacity plans and MPS in operation environments.	**L1& L3**
CO-4	Plan and implement suitable materials handling principles and practices in the operations.	**L2 & L3**
CO-5	Plan and implement suitable quality control measures in Quality Circles to TQM.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Production And Operations Management (MSPE-123)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Research and Publication Ethics**
Course Code: MSRE-121	**Title: Research and Publication Ethics**

Course Objectives:

1. To understand the importance of philosophy of science and ethics.
2. To identify research misconduct and predatory publications.
3. To understand the open access publications, research metrics.
4. To understand the usage of plagiarism tools.
5. To develop effective scientific communication skills for writing research papers, proposals, and presentations.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Philosophy and Ethics:** Definition of philosophy; nature and scopes; basic concepts; different branches. Define Ethics; moral philosophy; judgements and reactions.	9L
II	**Scientific Conduct:** Ethics in science and research; Intellectual honesty and research integrity. Scientific misconducts: Falsification; Fabrication and Plagiarism; Redundant. Publications: duplicate and overlapping publications; Selective reporting and misrepresentation of data.	9L
III	**Publication Ethics:** definition; importance; standards setting initiatives and guidelines: COPE, WAME, etc.; Conflicts of interest; Publication misconduct: definition; concept; unethical behavior; types; Violation of publication ethics; authorship and contributor ship; Identification, complaints and appeals for misconduct; Predatory publisher and journals.	9L
IV	**Open Access Publishing:** Open access publications and initiatives; SHERPA/RoMEO online resource to check publisher copyright & self-	9L

	archiving policies; Software tool to identify predatory publications developed by SPPU - Journal finger / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer, Journal Suggester, etc.	
V	**Publication Misconduct:** Use and importance of plagiarism software like Turnitin, Urkund and other open source software tools.	**9L**

Reference/ Text Books:

1. Nicholas H. Steneck. Introduction to the Responsible Conduct of Research. Office of Research Integrity. 2007. Available at: https://ori.hhs.gov/sites/default/files/rcrintro.pdf
2. The Student's Guide to Research Ethics By Paul Oliver Open University Press, 2003
3. Responsible Conduct of Research By Adil E. Shamoo; David B. Resnik Oxford University Press, 2003
4. Ethics in Science Education, Research and Governance Edited by Kambadur Muralidhar, Amit Ghosh Ashok Kumar Singhvi. Indian National Science Academy, 2019. ISBN : 978-81-939482-1-7.
5. Anderson B.H., Dursaton, and Poole M.: Thesis and assignment writing, Wiley Eastern 1997.
6. Bijorn Gustavii: How to write and illustrate scientific papers? Cambridge University Press.
7. Bordens K.S. and Abbott, B.b.: Research Design and Methods, Mc Graw Hill, 2008.
8. Graziano, A., M., and Raulin, M.,L.: Research Methods – A Process of Inquiry, Sixth Edition, Pearson, 2007.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To understand the fundamental concepts of philosophy and ethics in scientific research.	**L2 & L3**
CO-2	To identify and address various forms of scientific misconduct, including falsification, fabrication, and plagiarism.	**L3 &L4**
CO-3	To apply publication ethics standards and manage conflicts of interest in research and publication.	**L1& L3**
CO-4	To navigate open access publishing and utilize tools to identify predatory publications.	**L2 & L3**
CO-5	To effectively use plagiarism detection software to ensure research integrity and originality.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Research and Publication Ethics (MSRE-121)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Advanced Industrial Engineering**
Course Code: MEPE-121	**Title: Advanced Industrial Engineering**

Course Objectives:

1. To introduce the concept of productivity, factors influencing it, and various approaches to productivity appraisal and analysis within an enterprise.
2. To provide an understanding of work study techniques, including method study, work measurement, time study, and work sampling, to improve standard output.
3. To explore principles of layout and facilities planning, material flow patterns, and material handling systems, along with different types of material handling equipment.
4. To cover fundamental concepts and applications of value engineering and the Function Analysis System Technique.
5. To develop skills in applying productivity improvement strategies, including process optimization and cost reduction techniques, to enhance operational efficiency.

Nature of Paper: Theory (DSE)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Productivity:** Concept, Productivity improvement factors, Productivity appraisal, productivity analysis in the enterprise- The Kurosawa structural approach, Lawlor's approach, Gold's approach, Quick Productivity Appraisal approach (QPA), Inter-Firm Comparison (IFC).	**9L**
II	**Work Design:** Work study, Method study, Work measurement, Standard output, Time study, Work sampling, Process analysis. Facility Layout: Principles of layout and facilities planning,	**9L**
III	**Material flow:** flow patterns, Material handling systems, Types of material handling equipment. **Value Engineering:** Fundamental concepts and applications of value engineering, Function Analysis System Technique.	**9L**

IV	**Systems Engineering:** Introduction to Systems Engineering, Management Information System, Phases in System Engineering, System Life Cycle, System Maintenance.	**9L**
V	**Quality Control:** Understand quality control concepts and definitions. **Systems**: Overview of TQM, Six Sigma, and SPC. **Standards**: Introduction to ISO 9000 and other quality standards. **Tools**: Study tools like Pareto Analysis, Fishbone Diagram, Control Charts, and Histograms.	**9L**

Reference/ Text Books:

1. Prokopenko, J. "Productivity Management, A Practical Handbook", International Labour Organisation, 1992.
2. ILO, "Introduction to Work Study", George Kanawaty, 4th revised edition, Universal Book Corporation 2007.
3. Apple, J.M. "Plant layout and materials handling", Ronald Press Company, New York, 1977.
4. Tutty Herald G, "Compendium on Value Engineering", Indo-American Society, 1983.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the concept of productivity and apply various approaches for productivity improvement and appraisal in an enterprise.	**L2 & L3**
CO-2	Conduct work study techniques such as method study, work measurement, time study, and work sampling to determine standard output.	**L3 &L4**
CO-3	Design effective facility layouts and material handling systems by applying principles of layout and facilities planning.	**L1& L3**
CO-4	Implement value engineering concepts and use the Function Analysis System Technique to optimize product functions and reduce costs.	**L2 & L3**
CO-5	Apply systems engineering principles to manage information systems, understand the system life cycle, and maintain system operations.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Advanced Industrial Engineering (MEPE-121)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Computer Aided Manufacturing**
Course Code: MEPE-122	**Title: Computer Aided Manufacturing**

Course Objectives:

1. Understand the fundamentals of computer-aided programming, including APT programming and NC programming on CAD/CAM systems.
2. Learn about tooling systems for CNC machines, including interchangeable, preset, and modular tooling systems.
3. Explore DNC systems and adaptive control techniques, including their advantages, disadvantages, and applications in machining processes.
4. Gain knowledge of post processors for CNC systems, including their necessity, structure, and functions.
5. Develop skills in microcontrollers and PLCs, including their hardware components, programming, and applications in automation and CNC machines.

Nature of Paper: Theory (DSE)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Computer-Aided Programming:** General information, APT programming, Examples Apt programming probkms (2D machining only). NC programming on CAD/CAM systems, the design and implementation of post processors. Introduction to CAD/CAM software, Automatic Tool Path generation.	9L
II	**Tooling for CNC Machines:** Interchangeable tooling system, preset and qualified toois, coolant fed tooling system, modular fixturing, quick change tooling system, automatic head changers. **DNC Systems and Adaptive Control:** Introduction, type of DNC systems, advantages arid disadvantages of DNC, adaptive control with optimization, Adaptive control with constrains, Adaptive control of	9L

	machining processes like turning, grinding.	
III	**Post Processors for CNC:** Introduction to Post Processors: The necessity of a Post Processor, the general structure of a Post Processor, the functions of a Post Processor, DAPP — based- Post Processor: Communication channels and major variables in the DAPP — based Post Processor, th creation of a DAPP — Based Post Processor.	**9L**
IV	**Micro Controllers:** Introduction, Hardware components, I/O pins, ports, external memory:, counters, timers and serial data I/O interrupts. Selection of Micro Controllers Embedded Controllers, Applications and Programming of Micro Controllers. **Programming Logic Controllers (PLC' s):** Introduction, Hardware components of PLC, System, basic structure, principle of operations, Programming mnemonics timers, Internal relays and counters, Applications of PLC's in CNC Machines.	**9L**
V	**Computer Aided Process Planning,** Hybrid CAAP System, Computer Aided Inspection and quality control, Coordinate Measuring Machine, Limitations of CMM, Computer Aided Testing, Optical Inspection Methods, Artificial Intelligence and expert system: Artificial Neural Networks, Artificial Intelligence in CAD, Experts systems and its structures.	**9L**

Reference/ Text Books:

1. Systems approach to Computer Integrated Design and Manufacturing – Nana Singh, John Wiley, 1996.
2. Computer Aided Manufacturing – Tien Chien Chang, Richrad A. Wysk and Hsu-Pin Wang, Pearson Third Editon, 2012.
3. Computer Numerical Control, Operations and Programming – Jon Stenerson, Kelly Cuman, PHI.
4. Computer Control of Manufacturing Systems / Yoram Koren / Mc Graw Hill. 1983. 2. Computer Aided Design Manufacturing – K. Lalit Narayan, K. Mallikarjuna Rao and M.M.M. Sarcar, PHI, 2008.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology	
Category	**Max. Marks**
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Illustrate the principles and applications of computer-aided programming and	**L2 & L3**

	automatic tool path generation.	
CO-2	Describe various tooling systems for CNC machines and their impact on machining efficiency and flexibility.	**L3 &L4**
CO-3	Analyze DNC systems and adaptive control techniques, and apply them to optimize machining processes.	**L1& L3**
CO-4	Understand the role and functionality of post processors in CNC systems and develop basic post-processing solutions.	**L2 & L3**
CO-5	Demonstrate proficiency in programming and applying microcontrollers and PLCs for automation in manufacturing systems.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Computer Aided Manufacturing (MEPE-122)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: II**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Production Engineering Lab**
Course Code: MSPE-124P	**Title: Production Engineering Lab**

Course Objectives:

1. Analyze the morphology of chips produced from different materials and machining processes.
2. Evaluate the mechanical properties of metals through TIG and MIG welding experiments.
3. Measure and interpret tool face temperatures using thermocouple methods.
4. Assess the roughness of machined surfaces and its dependence on tool geometry and feed rate.
5. Study and apply the construction and operational parameters of various machining and extrusion setups.

Nature of Paper: Practical

Minimum Passing Marks: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 2 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical -1	Study of the morphology of chips produced from different materials sand machining processes.
Practical -2	Experiments on TIG and MIG welding to find out the mechanical properties of metals.
Practical -3	Evaluations of tool face temperature with thermocouple method.
Practical -4	Roughness of machined surface. Influence of tool geometry and feed rate.
Practical -5	Study of the construction and operating parameters of metal spinning Lathe.
Practical -6	Study of the water hammer equipment and hydrostatic extrusion setup.
Practical -7	Extrusion of cylindrical billets through dies of different included angles and exit diameters.
Practical -8	Effect of tool geometry on chip flow direction in simulated orthogonal cutting conditions.

Practical -9	Practice and study of blanking and punching process and their characteristic features on mechanical press with existing dies.
Practical -10	Study of cutting ratio/chip thickness ratio in simulated orthogonal cutting with different materials and tool geometry.

Reference/Text Books:

1. *"Manufacturing Engineering and Technology" by Serope Kalpakjian and Steven Schmid*
2. *"Fundamentals of Machining and Machine Tools" by Geoffrey Boothroyd and Winston A. Knight*
3. *"Welding: Principles and Applications" by Larry Jeffus*
4. *"Introduction to Fluid Mechanics" by Robert W. Fox, Alan T. McDonald, and Philip J. Pritchard*
5. *"Metal Cutting Principles" by David A. Stephenson and John S. Agapiou*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Identify and analyze chip morphology from different machining processes.	**L2 & L3**
CO-2	Evaluate the mechanical properties of welded metals using TIG and MIG techniques.	**L3 &L4**
CO-3	Measure and analyze tool face temperatures in machining operations.	**L1& L3**
CO-4	Understand and assess surface roughness related to tool geometry and feed rates.	**L2 & L3**
CO-5	Operate and analyze various metal spinning, extrusion, and cutting processes, including their effects on material properties and process efficiency.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Production Engineering Lab (MSPE-124P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Simulation, Modelling & Analysis**
Course Code: MEPE-231	**Title: Simulation, Modelling & Analysis**

Course Objectives:
1. Define the basics of simulation modeling and replicating the practical situations in organizations
2. Generate random numbers and random variates using different techniques.
3. Develop simulation model using heuristic methods.
4. Analysis of Simulation models using input analyzer, and output analyzer
5. Explain Verification and Validation of simulation model.

Nature of Paper: Theory (DSE-III)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction: Simulation:** a tool, advantages and disadvantages of simulation, areas of application, systems and system environment, components of a system, discrete and continuous systems, discrete event system simulation. **General Principles:** Concepts in discrete event simulation, time advance algorithm, manual simulation using event scheduling, basis properties and operations.	**9L**
II	**Models In Simulation:** Terminology and concepts, statistical models: queuing systems; inventory systems; reliability and maintainability, limited data, discrete distributions: Bernoulli distribution; Bionomial distribution; Geometric distribution, continuous distribution: Uniform distribution; Exponential distribution; Gamma distribution; Normal distribution; Weibull distribution; Triangular Distribution; Lognormal distribution, poisson process,	**9L**
III	**Queueing Models:** Characteristics of queuing systems, the calling population, system capacity, arrival process, service mechanism, queuing	**9L**

	notations, long run measures of performance of queuing systems, server utilization in G/G/1/∞/∞ queues, server utilization in G/G/C/∞/∞ queues, server utilization and system performance, costs in queuing problems, Larkovian models.	
IV	**Random Number Generation:** Properties of random numbers, Pseudo random numbers, techniques of generating random numbers, tests of random numbers. **Random Variate Generation:** Inverse transform technique, Direct transformation for the Normal and Lognormal distribution, Convolution Method, Acceptance rejection technique.	**9L**
V	**Input Modelling And Validation:** Steps in the development of model, data collection, Distribution identification, Parameter estimation, Goodness of Fit Tests, selecting input models without data, verification and validation of simulation models.	**9L**

Reference/ Text Books:

1. Simulation Modelling and Analysis by Law and Kelton, Mc Graw Hill.
2. Simulation Model Design& execution by Fishwich, Prentice Hall.
3. Discrete event system simulation by Banks, Carson, Nelson and Nicol.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Describe the role of important elements of discrete event simulation and modeling paradigm.	**L2 & L3**
CO-2	Conceptualize real world situations related to systems development decisions, originating from source requirements and goals.	**L3 &L4**
CO-3	Develop skills to apply simulation software to construct and execute goal-driven system models.	**L1& L3**
CO-4	Interpret the model and apply the results to resolve critical issues in a real world environment.	**L2 & L3**
CO-5	Evaluate and improve system performance through analysis of simulation results and iterative model refinement.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Simulation, Modeling & Analysis (MEPE-231)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Quality Engineering in Manufacturing**
Course Code: MEPE-232	**Title: Quality Engineering in Manufacturing**

Course Objectives:

1. To introduce the overall quality system, including quality engineering in production design and processes, and understanding the economic implications of tightening tolerances.
2. To provide knowledge on functional limits, tolerance design for different characteristics, and parameter design strategies.
3. To teach various analysis of variance (ANOVA) methods and their applications in quality engineering.
4. To explore test strategies using orthogonal arrays and methods for interpreting experimental results.
5. To cover ISO-9000 quality systems, Six Sigma, benchmarking, quality circles, and problem analysis techniques.

Nature of Paper: Theory (DSE)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Quality Value and Engineering:** An overall quality system, quality engineering in production design, quality engineering in design of production processes. Loss Function and Quality Level: Derivation and use of quadratile loss function, economic consequences of tightening tolerances as a means to improve quality, evaluations and types tolerances.(N-type, S-type and L-type)	**9L**
II	**Tolerance Design and Tolerancing:** Functional limits, tolerance design for N-type. L-type and S-type characteristics, tolerance allocation fbr multiple components. Parameter and Tolerance Design: Introduction to parameter design, signal to noise ratios, Parameter design strategy, some of the case studies on parameter and tolerance designs.	**9L**
III	**Analysis of Variance (ANOVA):** NO-way ANOVA, One-way	**9L**

	ANOVA, Two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.	
IV	**Orthogonal Arrays:** Typical test strategies, better test strategies, efficient test strategies, steps in designing, conducting and analyzing an experiment. Interpolation of Experimental Results: Interpretation methods, percent contributor, estimating the mean.	**9L**
V	**Quality System:** ISO-9000 Quality System, BDRE, 6.-sigma, Bench making, Quality circles Brain Storming — Fishbone diagram — problem analysis.	**9L**

Reference/ Text Books:

1. Taguchi Techniques for Quality Engineering / Phillip J. Ross / McGraw Hill, Intl. II Edition, 1995.
2. Quality Engineering in Production systems I G. Taguchi, A. Elsayed et al / Mc.Graw Hill Intl. Edition, 1989.
3. Taguchi Methods explained: Practical steps to Robust Design / Papan P. Bagchi I Prentice Hall md. Pvt. Ltd., New Delhi.
4. Design of Experiments using the Taguchi Approach/Ranjit K. Roy, John wiley & sons. Inc. 2001.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3)Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand quality value and engineering concepts, including the derivation and application of the quadratic loss function and the economic consequences of improving quality through tightened tolerances.	**L2 & L3**
CO-2	Apply tolerance design techniques for different types of characteristics and perform parameter design using signal-to-noise ratios.	**L3 &L4**
CO-3	Conduct and critique various ANOVA methods, including one-way and two-way ANOVA, and analyze data for multiple level factors.	**L1& L3**
CO-4	Utilize orthogonal arrays for efficient test strategies, design and conduct experiments, and interpret experimental results using different methods.	**L2 & L3**
CO-5	Implement ISO-9000 quality systems, apply Six Sigma principles, and use quality improvement tools such as benchmarking, quality circles, and fishbone diagrams for problem analysis.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Quality Engineering in Manufacturing (MEPE-232)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Rapid Prototyping Technologies**
Course Code: MEPE-233	**Title: Rapid Prototyping Technologies**

Course Objectives:

1. Understand the fundamentals, historical development, and classification of rapid prototyping processes.
2. Explore and compare various rapid prototyping systems, including liquid-based, solid-based, and powder-based methods, along with their advantages and limitations.
3. Learn about rapid tooling methods, including indirect and direct approaches, and their applications in manufacturing.
4. Analyze rapid prototyping data formats, software tools, and their implications for model accuracy and functionality.
5. Examine the diverse applications of rapid prototyping across industries such as aerospace, automotive, jewelry, medical, and bioengineering.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, Commonly used Terms, Classification of RP process, Rapid Prototyping Process Chain: Fundamental Automated Processes, Process Chain.	**9L**
II	**Liquid-based Rapid Prototyping Systems:** Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. **Solid ground curing (SGC):** Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies	**9L**

	Solid-based Rapid Prototyping Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.	
III	**Powder Based Rapid Prototyping Systems:** Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three-dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. **Rapid Tooling:** Introduction to Rapid Tooling (RT), Conventional Tooling Vs. RT, Need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods: Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, Investment Casting, Spin Casting, Die casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.	**9L**
IV	**Rapid Prototyping Data Formats:** STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Rapid Prototyping Software's: Features of various RP software's like Magic's, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor.	**9L**
V	**RP Applications:** Application – Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. **RP Medical and Bioengineering Applications:** Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules.	**9L**

Reference/ Text Books:

1. Rapid prototyping: Principles and Applications - Chua C.K., Leong K.F. and LIM C.S, World Scientific publications , Third Edition, 2010.
2. Rapid Manufacturing – D.T. Pham and S.S. Dimov, Springer, 2001
3. Whalers Report 2000 – Terry Wohlers, Wohlers Associates, 2000 Rapid Prototyping & Manufacturing – Paul F. Jacobs, ASME Press, 1996.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-

3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Generating a good understanding of RP history, its development and applications. Expose the students to different types of Rapid prototyping processes, materials used in RP systems and reverse engineering.	**L2 & L4**
CO-2	Students will be exposed to different types of Rapid prototyping processes, materials used in RP systems and reverse engineering.	**L2 & L3**
CO-3	Students gain knowledge to develop prototypes	**L1& L3**
CO-4	Students learn the concepts of rapid tool processing	**L3 &L4**
CO-5	Apply rapid prototyping techniques to real-world applications in design, engineering, and industry-specific scenarios.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Rapid Prototyping Technologies (MEPE-233)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	3	2	3	1	2	0	0	0	0	0	3
CO-2	2	3	2	3	1	2	0	0	0	0	0	3
CO-3	2	3	2	3	1	2	0	0	0	0	0	3
CO-4	2	3	2	3	1	2	0	0	0	0	0	3
CO-5	2	3	2	3	1	2	0	0	0	0	0	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Finite Element Techniques**
Course Code: MECS-234	**Title: Finite Element Techniques**

Course Objectives:

1. To introduce the fundamental concepts of the Finite Element Method (FEM), including stress, equilibrium, boundary conditions, and strain-displacement relations.
2. To provide knowledge on finite element modeling for one-dimensional problems, trusses, frames, and beams.
3. To explore finite element modeling for two-dimensional stress analysis, including constant strain triangles, isoparametric elements, and axisymmetric solids.
4. To cover steady-state heat transfer, time-dependent field problems, and dynamic analysis using FEM.
5. To develop skills in applying FEM for practical engineering problems, including verification of results and optimization of solutions.

Nature of Paper: Theory (DSE)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Finite Element Method** of solving field problems. Stress and Equilibrium. Boundary conditions. Strain-Displacement relations. Stress-strain relations. **One Dimensional Problem:** Finite element modeling. Local, natural and global coordinates and shape functions. Potential Energy approach: Assembly of Global stiffness matrix and load vector. Finite element equations, treatment of boundary conditions. Quadratic shape functions.	**9L**
II	**Analysis of trusses and frames**: Analysis of plane truss with number of unknowns not exceeding two at each node. Analysis of frames with two translations and a rotational degree of freedom at each node. Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom	**9L**

	per node for beam element. Solid-based Rapid Prototyping Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.	
III	**Finite element modeling of two-dimensional** stress analysis problems with constant strain triangles and treatment of boundary conditions. Two dimensional four noded isoparametric elements and numerical integration. Finite element modeling of Axisymmentric solids subjected of axisymmetric loading with triangular elements. Convergence requirements and geometric isotropy.	**9L**
IV	**Steady state heat transfer analysis**: One dimensional analysis of a fin and two-dimensional conduction analysis of thin plate. Time dependent field problems: Application to one dimensional heat flow in a rod. Dynamic analysis: Formulation of finite element modeling of Eigen value problem for a stepped bar and beam. Evaluation of Eigen values and Eigen vectors. Analysis of a uniform shaft subjected to torsion using Finite Element Analysis	**9L**
V	**Finite element formulation** of three-dimensional problems in stress analysis. Finite Element formulation of an incompressible fluid. Potential flow problems Bending of elastic plates. Introduction to non-linear problems and Finite Element analysis software.	**9L**

Reference/ Text Books:

1. Tirupathi R Chandraputla and Ashok. D. Belegundu, Introduction of Finite Element in Engineering, Prentice Hal of India, 1997.
2. Rao S.S., The Finite Element Methods in Engineering, Pergamon Press, 1989.
3. Segerland. L.J., Applied Finite Element Analysis, Wiley Publication, 1984.
4. Reddy J.N., An Introduction to Finite Element Methods, Mc Graw Hil Company, 1984.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the fundamental concepts of FEM, including stress, equilibrium,	**L2 & L3**

	boundary conditions, and strain-displacement relations.	
CO-2	Model and analyze one-dimensional problems using finite element methods.	**L2 & L4**
CO-3	Perform finite element modeling for two-dimensional stress analysis problems, including constant strain triangles, isoperimetric elements, and axisymmetric solids.	**L1& L3**
CO-4	Analyze steady-state heat transfer, time-dependent field problems using FEM.	**L2 & L3**
CO-5	Formulate and solve three-dimensional problems in stress analysis.	**L3 &L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Finite Element Techniques (MEPE-234)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	2	1	1	2	0	0	0	0	0	1
CO-2	2	3	2	2	2	2	0	0	0	0	0	1
CO-3	3	3	1	2	1	2	0	0	0	0	0	2
CO-4	2	3	2	1	2	1	0	0	0	0	0	2
CO-5	3	2	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech In Production Engineering**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Seminar**
Course Code : MSPE-231P	**Title: Seminar**

Course Objectives:

1. To develop the ability to explore and understand advanced topics in production engineering through literature review and research articles.
2. To enhance students' skills in technical communication through oral presentations and report writing.
3. To encourage independent thinking, critical analysis, and creative approaches in exploring research problems.
4. To improve the ability to summarize and present technical content in a coherent and professional manner.
5. To prepare students for future research or industrial challenges through exposure to current trends and technological advancements.

Nature of Paper: PRACTICAL

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 16 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=2Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
1	**Students Prepare their Project Thesis and present.**	16

Evaluation/Assessment Methodology

Category	Max, Marks
1) Class tasks/ Sessional Examination	-
2) Presentations /Seminar	20
3) Assignments	-
4) Research Project Report Seminar On Research Project Report	20
5) ESE	60

Total:		**100**
Prerequisites for the course:		
Course Learning Outcomes:		
CO-1	Identify and select a relevant research topic from advanced areas of production engineering.	**L2**
CO-2	Conduct an effective literature review to gather and evaluate recent developments related to the chosen topic.	**L3**
CO-3	Analyze and interpret technical content to draw meaningful insights and present logical conclusions.	**L4**
CO-4	Prepare a concise and well-structured technical report in accordance with academic and professional standards.	**L3**
CO-5	Deliver a clear and confident oral presentation with appropriate use of visual aids and communication strategies.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	1	0	0	0	1	2	3
CO-2	3	3	3	2	1	1	0	0	0	1	1	3
CO-3	3	3	3	3	1	0	0	0	0	0	1	3
CO-4	3	3	3	2	2	1	0	0	0	1	2	3
CO-5	3	3	3	3	2	1	0	0	0	0	1	3

Foramt-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech In Production Engineering**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Synopsis of Dissertation**
Course Code : MSPE-232P	**Title: Synopsis of Dissertation**

Course Objectives:

1. To guide students in identifying a suitable and relevant research problem in the domain of Production Engineering.
2. To develop the ability to review scientific literature and understand the research gap.
3. To enhance the student's capability in formulating research objectives and methodology.
4. To cultivate skills in technical documentation and formal writing of a research synopsis.
5. To prepare students for initiating independent research with a strong foundation and clear research direction.

Nature of Paper: PRACTICAL

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 16 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=2Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
1	Students Prepare their Project Thesis and present.	**16**

Evaluation/Assessment Methodology

Category	Max, Marks
1) Class tasks/ Sessional Examination	-
2) Presentations /Seminar	30
3) Assignments	-
4) Research Project Report Seminar On Research Project Report	30
5) ESE	90
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:		
CO-1	Identify a research-worthy problem relevant to production engineering.	**L2**
CO-2	Conduct a structured literature review to determine research gaps and define objectives.	**L3**
CO-3	Formulate a research plan, including problem definition, hypothesis, and methodology.	**L4**
CO-4	Prepare a well-structured synopsis document adhering to academic and research guidelines.	**L3**
CO-5	Defend the proposed research work confidently through oral presentation and technical justification.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	3	2	2	1	0	0	0	1	2	3
CO-2	3	3	3	2	1	1	0	0	0	1	1	3
CO-3	3	3	3	3	1	0	0	0	0	0	1	3
CO-4	3	3	3	2	2	1	0	0	0	1	2	3
CO-5	3	3	3	3	2	1	0	0	0	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: PG(R) **Class: M.Tech In Production Engineering**	**Year: II** **Semester: IV**
Credits: 10 **Theory: 0** **Practical: 10**	**Subject: Final Dissertation**
Course Code: MSPE-241P	**Title: Final Dissertation**

Course Objectives:

1. To enable students to identify and formulate engineering problems through literature review.
2. To develop skills in designing experimental or theoretical approaches to solve engineering problems.
3. To enhance technical writing and documentation skills through project reports.
4. To promote teamwork and project management skills.
5. To develop the ability to critically evaluate results and present conclusions effectively.

Nature of Paper: PRACTICAL

Minimum Passing Marks/Credits: 50% Marks / 10 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 16 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=2Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
1	Students Prepare their Project Thesis and present.	16

Evaluation/Assessment Methodology

Category	Max, Marks
1) Class tasks/ Sessional Examination	-
2) Presentations /Seminar	30
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	30
5) ESE	120
Total:	**200**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Identify and define a real-world engineering problem through critical literature review.	**L2**
CO-2	Apply engineering concepts and tools to develop and implement an effective solution.	**L3**
CO-3	Analyze data, interpret results, and draw logical conclusions based on the research findings.	**L4**
CO-4	Prepare and present a comprehensive dissertation report with proper technical writing and formatting.	**L3**
CO-5	Demonstrate effective communication, teamwork, and project management skills during project execution and presentation.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	3	2	2	1	0	0	0	1	2	3
CO-2	3	3	3	2	1	1	0	0	0	1	1	3
CO-3	3	3	3	3	1	0	0	0	0	0	1	3
CO-4	3	3	3	2	2	1	0	0	0	1	2	3
CO-5	3	3	3	3	2	1	0	0	0	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: PG(R) **Class: M.Tech In Production Engineering**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Comprehensive Viva**
Course Code : MSPE-242P	**Title: Comprehensive Viva**

Course Objectives:
1. To assess the students' overall understanding of core mechanical engineering subjects.
2. To encourage the integration of knowledge acquired from various courses throughout the program.
3. To develop the ability to respond to technical questions with clarity and confidence.
4. To prepare students for real-life engineering interviews and oral examinations.
5. To evaluate the students' problem-solving, analytical, and communication skills.

Nature of Paper: PRACTICAL

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 0
T: 0
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=2Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
1	**Comprehensive Viva about their Project.**	-

Evaluation/Assessment Methodology

Category	Max, Marks
1) Class tasks/ Sessional Examination	-
2) Presentations /Seminar	40
3) Assignments	-
4) Research Project Report Seminar On Research Project Report	-
5) ESE	60
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Recall and explain fundamental concepts from core mechanical engineering subjects.	**L2**

CO-2	Demonstrate an integrated understanding of multiple subjects to address viva questions.	**L3**
CO-3	Apply theoretical knowledge to solve interdisciplinary problems posed during the viva.	**L4**
CO-4	Analyze and justify answers logically during technical discussions.	**L3**
CO-5	Communicate technical information clearly and confidently during oral assessments.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	0	0	0	1	0	0	0	1	2	1
CO-2	3	3	2	1	0	1	0	0	0	1	1	2
CO-3	3	3	3	2	1	0	0	0	0	0	1	2
CO-4	2	3	2	2	0	1	0	0	0	1	2	2
CO-5	0	0	0	0	0	1	0	0	0	0	1	1

Format-3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Composite Materials**
Course Code: MSPE-111	**Title: Composite Materials**

Course Objectives:

1. Understand the basic concepts, classifications, and characteristics of composite materials and their applications.
2. Analyze the effects of reinforcement properties on composite performance.
3. Learn various manufacturing methods for metal, ceramic, and polymer matrix composites.
4. Evaluate and design for composite strength using different failure criteria and stress analysis methods.
5. Explore the environmental and sustainability aspects of composite materials, including recycling and lifecycle analysis.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION:** Definition–Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.	**9L**
II	**REINFORCEMENTS:** Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.	**9L**
III	**Manufacturing of Metal Matrix Composites:** Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications.	**9L**

	Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.	
IV	**Manufacturing of Polymer Matrix Composites:** Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.	**9L**
V	**Strength:** Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.	**9L**

Reference/ Text Books:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
3. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.
4. Composite Materials Science and Applications – Deborah D.L. Chung.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the classifications, characteristics, and applications of various composite materials.	**L2 & L3**
CO-2	Analyze the functional roles of reinforcement and matrix in composites and their effects on overall performance.	**L3 &L4**
CO-3	Prepare and process different types of reinforcements such as glass fibers, carbon fibers, Kevlar fibers, and boron fibers.	**L1& L3**
CO-4	Apply the rule of mixtures and understand mechanical behavior under isostrain and isostress conditions.	**L2 & L3**
CO-5	Utilize various manufacturing techniques for metal matrix, ceramic matrix, and polymer matrix composites.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Composite Materials (MSPE-111)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	3
CO-2	3	3	3	2	1	2	0	0	0	0	0	2
CO-3	3	2	2	2	2	2	0	0	0	0	0	1
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	3	0	0	0	0	0	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Advanced Casting and Welding Technologies**
Course Code: MSPE-112	**Title: Advanced Casting and Welding Technologies**

Course Objectives:
1. Study of various metal casting and joining processes
2. Control of parameters for sound casting and welding
3. Thermal and fluid transfer mechanism during these processes
4. Metallurgical effects of casting and joining
5. Analyze defects in casting and welding processes and develop strategies for their prevention and remediation.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Laser Beam Welding:** Types of lasers, equipment, power calculation, applications, dual laser beam welding, use of fiber optics in LBW. **Friction Stir Welding**; Details of process and process parameters, specific applications. **Electron Beam Welding**; The interaction of electron beam with matter, mode of heat generation, mode of energy losses, details of the equipment, product design for EBW, case studies. **Ultrasonic Welding**; Propagation of ultrasonic waves in matter, mode of joint formation, joint types and design of product for ultrasonic welding, details of equipment and case studies cutting and gauging, flame cutting plasma arc welding, laser assisted cutting.	**9L**
II	**Heat flow in Welding:** Significance, theory of heat flow cooling rate determination, selection of welding parameters based on heat flow analysis,	**9L**

	residual stresses and distortion. Joint design, analysis of fracture and fatigue of welded joints. Automated welding systems.	
III	Investment casting, shell moulding, squeeze casting, vacuum casting, counter-gravity flow-pressure casting, directional and monocrystal solidification, squeeze casting, semisolid metal casting, rheocasting.	**9L**
IV	Solidification Gating and Risering, Nucleation and grain growth, solidification of pure metals, short and long freezing range alloys. Gating and risering desing calculations, Fluidity and its measurement.	**9L**
V	**CAE of Welding and Casting:** Design of weldment, application of finite element method in welding – determination of distortion in weldments, modeling of temperature distribution – case studies. Design for casting, application of finite element method in casting- determination of hot spots, location of turbulence and other defects, modeling of flow in molds, modeling of heat transfer in castings- case studies.	**9L**

Reference/ Text Books:

1. Ravi B, "Metal Casting: Computer Aided Design and Analysis" Prentice Hall, 2005.
2. Richard L Little, "Welding and Welding Technology" Tata McGraw Hill, 2004.
3. John Campbell, "Casting Practice" Elsevier Science Publishing Co., 2004.
4. Larry Jeffus, "Welding Principles and Applications" Delmar Publishers, 2004.
5. John Campbell "Casting Butterworth Heinemann, 2003.
6. Klas Weman: Welding Processes Handbook", 2003.
7. Howard B Cary, "Modern Welding Technology" Prentice Hall, 2002.
8. Larry Jeffus, "Welding for Collision Repair", Delmar Publishers, 1999.
9. ASM Hand Book "Casting", ASM International 1998.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Discriminate the knowledge of principles, operations and applications of different casting and welding processes.	**L2 & L3**
CO-2	Analyze the effects of process parameters on the quality of cast and weld products.	**L3 &L4**
CO-3	Select the NDT techniques for the evaluation of cast and weld components.	**L1& L3**
CO-4	Apply the knowledge of welding in Heavy Engineering and nuclear industries.	**L2 & L3**

CO-5	Evaluate and mitigate defects in casting and welding processes through appropriate techniques and process adjustments.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Advanced welding & Casting Technology (MSPE-112)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	2	3	1	3	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	1
CO-3	3	2	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	1	2	1	1	0	0	0	0	0	3
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Advanced CAD**
Course Code: MSPE-113	**Title: Advanced CAD**

Course Objectives:

1. To impart fundamental knowledge to students in the latest technological topics on Computer Aided Design to broaden and deepen their capabilities.
2. To impart fundamental knowledge on Finite Element Methods to analyze the real life design in the industry.
3. To inculcate the ability to work with inter-disciplinary groups in professional, industry and research organizations.
4. To design and validate technological solutions to defined problems and communicate clearly and effectively for the practical application of their work.
5. To foster a continuous learning attitude to adapt to evolving technologies and methodologies in Computer Aided Design and Finite Element Analysis.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION TO CAD:** Definition of Cad, Design Criteria, Design Tool, Cad Tools, Design Analysis, Functional Areas CAD, and CAD Softwares and their efficient use. **GEOMETRIC MODELLING**: Interpolation and Extrapolation of Curves, Properties of Splines, Wire Frame Modeling: Wire Frame Entities and Modeling. **SYNTHETIC CURVES:** Hermite, Bezier and B-spline Curves and their properties.	**9L**
II	**SURFACE MODELING:** Analytic and Synthetic surfaces. Planar rule, surface of revolution, Tabulated cylinder. **SYNTHETIC SURFACE:** Bi cubic, Bezier, B-spline and NURBS	**9L**

	Surfaces.	
III	**ADVANCED SURFACES:** Coons, Blending, Sculptured Surfaces. Surface Manipulation, Displaying Segmentation, Trimming, intersection. **TRANSFORMATIONS:** 2-D and 3-D Transformations, Homogeneous Transformation and Concatenation.	**9L**
IV	**3-D MODELLING:** B-Rep, C-Rep, Cell Decomposition, Spatial occupancy and Enumeration, Primitive Instancing. **GRAPHICS STANDARDS:** IGES, STEP, ACIS and DXF. **DESIGN APPLICATIONS:** Mechanical Tolerances, Mass Properties, Mechanical Assembly, Finite Element Modeling (Mesh).	**9L**
V	**COLLOBORATIVE-ENGINEERING:** Collaborative Design, Mockup Design, Morphology, Behavioural and Feature Based Modeling and Analysis, Sensitivity analysis, Conceptual, Bottom up and Top down Design Approach.	**9L**

Reference/ Text Books:

1. Mathematical Elements For Computer Graphics – David Rosers, 2nd Edition Tata Mc Graw Hill 2002.
2. CAD/CAM, Principles and Applications, 3rd Edition Tata Mc Graw Hill 2010.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the basic fundamentals of computer aided design and computer devices.	**L2 & L3**
CO-2	To learn 2D & 3D transformations of the basic entities like line, circle, etc. and coordinate system	**L3 &L4**
CO-3	To understand the different geometric modeling techniques like solid modeling, surface modeling, and to visualize how the components look like before its manufacturing or fabrication.	**L1& L3**
CO-4	To learn at least one high end design software	**L2 & L3**
CO-5	To learn the design analysis through Finite Element Method.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Advanced CAD (MSPE-113)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	3	2	2	2	0	0	0	0	0	3
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	2	2	1	1	3	0	0	0	0	0	3
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Research Methodology**
Course Code: MSRM-111	**Title: Research Methodology**

Course Objectives:
1. To introduce with Research Methodology and its importance.
2. To study the concept of research design.
3. To determination of data collection, analysis, and their interpretation.
4. To know the types of research reports and plagiarism.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction;** Meaning of Research; Objectives; Types; Approaches Adopted in research; Significance; Methodology; different Criteria of Research; and Challenges Faced by Researchers in India; Definition and selection of the Research Problem; Importance of literature review.	9L
II	**Research Design:** Meaning; Methods of research design; Important Concepts Relating to Research Design, Types; and Basic Principles of Designs.	9L
III	**Design of Sampling:** Introduction; Sampling techniques; Errors; Sample Survey; Types of Sampling. **Data Collection:** Types of Data, Classifications of Measurement Scales, Error in Measurement Tools, Scaling, Scaling Technics, Deciding the Scale; Collection of data; Methods of Data Collection.	9L
IV	**Testing of Hypotheses:** Basic Concepts; Hypothesis Testing; Statistics and Critical Region; Procedure for Hypothesis Testing, Limitations; Interpretation of results.	9L
V	**Interpretation and Report Writing:** Introduction; Methods of Interpretation; Precaution; Significance of Report Writing, Different Steps	9L

	in Writing Report, Layout of the Research Report, Types of Reports, Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and referencing styles, Research Journals, Indexing and citation of Journals, Intellectual property, Plagiarism.	

Reference/ Text Books:

1. C. R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques, New Age International publishers, Third Edition.
2. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition, SAGE, 2005.
3. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition.
4. Creswell, John W. Research design: Qualitative, quantitative, and mixed methods approach. Sage publications, 2013.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Discuss the importance of the research methodology and its technique.	**L2 & L3**
CO-2	Understand the importance of literature review in research.	**L3 &L4**
CO-3	Use different methods of research design and data collections.	**L1& L3**
CO-4	Understand the several parametric tests of hypotheses.	**L2 & L3**
CO-5	To evaluate the problems and set hypotheses.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1: Remember, L2: Understand, L3: Apply, L4: Analyze)

CO-PO Mapping
Research Methodology (MSRM-111)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Hybrid Manufacturing**
Course Code: MEPE-111	**Title: Hybrid Manufacturing**

Course Objectives:

1. Introduce the concepts, challenges, and feasibility of hybrid machining processes.
2. Understand the principles, mechanisms, advantages, disadvantages and applications of electrochemical and chemical machining processes.
3. Explore hybrid machining processes involving mechanical and thermal interactions, such as EDM with ultrasonic assistance and abrasive hybrid machining.
4. Examine the integration of multiple machining techniques to enhance process efficiency and product quality.
5. Analyze case studies and practical applications to demonstrate the benefits and limitations of hybrid machining processes.

Nature of Paper: Theory (DSE)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Hybrid Machining Processes:** Introduction, Needs of Hybridization of the machining process, Challenges and feasibility of process.	**9L**
II	**Chemical and Electro-chemical Type Material Removal Processes:** Principle, working advantages, disadvantages and applications of Electrochemical, Chemical machining, Economy aspects of ECM, Electro-chemical deburring and honing. Mechanical and Thermal interaction, Electrical Hybrid Machining Processes(ECDM, ECAM), Electrical Discharge Machining with Ultrasonic Assistance (EDMUS)	**9L**
III	**Abrasive Hybrid Machining** (AHM) Processes, Abrasive Electro chemical Machining processes, Electro chemical assistance of Ultrasonic Machining (USMEC), Abrasive Electrical Discharge Grinding	**9L**
IV	**Laser Assisted Micromachining:** Laser-assisted etching (LAE), Electro	**9L**

	chemical Micromaching with Laser Assistance (ECML),	
V	**Methods of Metal Deposition**: Thermal Spray Coating: Vapor Deposition Chemical Vapor Deposition	**9L**

Reference/ Text Books:

1. Advance Machining Processes V.K. Jain New Age.
2. Modern Machining Processes P.C. Pandey New Age.
3. Manufacturing Processes Degarmo.
4. Manufacturing Processes Kalpakjian Tata McGraw-Hill International.
5. Amitabh Gosh and A.K. Mallik, "Manufacturing Science", Affiliated East-West Press Pvt. Ltd., 1985.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the concepts and needs for hybridization of machining processes, along with the associated challenges and feasibility.	**L2 & L3**
CO-2	Explain the principles, working mechanisms, advantages, and disadvantages of electrochemical and chemical machining processes, including their economic aspects.	**L3 &L4**
CO-3	Analyze the interactions between mechanical, thermal, and electrical processes in hybrid machining, and apply techniques such as EDM with ultrasonic assistance and abrasive hybrid machining.	**L1& L3**
CO-4	Implement laser-assisted micromachining techniques, including laser-assisted etching and electrochemical micromachining with laser assistance.	**L2 & L3**
CO-5	Apply various metal deposition methods, such as thermal spray coating and chemical vapor deposition, in manufacturing processes.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1: Remember, L2: Understand, L3: Apply, L4 : Analyze)

CO-PO Mapping Hybrid Manufacturing (MEPE-111)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Computer Aided Manufacturing**
Course Code: MEPE-122	**Title: Computer Aided Manufacturing**

Course Objectives:

1. Introduce the principles, equipment, and applications of various non-traditional machining processes.
2. Analyze the mechanics, models, and parametric influences on process capabilities and material removal rates.
3. Understand the principles and performance characterization of laser beam, plasma arc, and electron beam machining.
4. Examine the principles, equipment, and applications of electrochemical machining and processing of ceramics.
5. Explore advanced manufacturing techniques such as e-manufacturing, nanotechnology, micromachining, and high-speed machining.

Nature of Paper: Theory (DSE)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Surface treatment:** Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating, Electro forming, Chemical vapour deposition, thermal spraying, lon implantation, diffusion coating, Diamond coating and cladding.	**9L**
II	**Non-Traditional Machining:** Introduction, need AJM, Parametric Analysis, Process capabilities, USM-Mechanics of Cutting, models, Parametric Analysis, WJM – principles, equipment, generators, analysis of R-C circuits, MRR, Surface finish, WEDM.	**9L**
III	**Laser Beam Machining:** Principles of working, equipment, Material removal rate, Process parameters, performance characterization, applications.	**9L**

	Plasma Arc Machining: Principles of working, equipment, Material removal rate, Process Parameters, performance characterization, applications **Electron Beam Machining:** Principle of working equipment, Material removal rate, Process performance characterization, applications **Electro Chemical Machining:** Principle of working, equipment, Material removal rate, Process parameters, performance characterization, applications	
IV	**Processing of ceramics:** Applications characteristics, classification Processing of particulate ceramics, Powder preparations, consolidation, Drying, sintering, Hot compaction, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.	**9L**
V	**Fabrication of Microelectronics devices:** Crystal growth and wafer preparation, Film deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in microelectronics, surface mount technology, Integrated circuits economics. E-Manufacturing, nanotechnology, and micromachining, High speed Machining	**9L**

Reference/ Text Books:

1. Manufacturing Engineering and Technology, Kalpakijian, Adisson Wesley 1995.
2. Process and Materials of Manufacturing RA Lindburg 4th edition PHI 1990.
3. Foundation of MEMS/Chang Liu/ Pearson, 2012.
4. Advanced Machining Processes VKJ in, Allied Publications.
5. Introduction to Manufacturing Processes, John A Schey, Mc Graw Hill.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the principles and applications of non-traditional machining processes.	**L2 & L3**
CO-2	Analyze the parametric influences and performance characteristics of various machining techniques.	**L3 &L4**
CO-3	Evaluate the material removal rates and process parameters for laser, plasma arc, and electron beam machining.	**L1& L3**

CO-4	Apply knowledge of electrochemical machining and ceramic processing in practical scenarios.	**L2 & L3**
CO-5	Explore advanced manufacturing technologies, including e-manufacturing, nanotechnology, and high-speed machining.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Advanced Manufacturing Processes (MEPE-112)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: I**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Advanced Casting and Welding Technologies Lab**
Course Code: MSPE-112P	**Title: Advanced Casting and Welding Technologies Lab**

Course Objectives:

1. Study the principles, operations, and applications of different casting and welding processes.
2. Analyze the effects of process parameters on the quality of cast and weld products.
3. Investigate the thermal and fluid transfer mechanisms during welding and casting.
4. Explore the metallurgical effects of casting and welding processes.
5. Develop skills in non-destructive testing (NDT) techniques for evaluating cast and weld components.

Nature of Paper: Practical

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 2 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical -1	Study of arc characteristics in simulated MMA welding; arc gap-arc voltage relationship; recording of voltage oscillograms and its study.
Practical -2	Study of heat flow and temperature distribution in welding
Practical -3	Study of characteristics of TIG/MIG welding
Practical -4	Ultrasonic/dye penetrant inspection or computer simulation of welding heat flow/analysis of arc voltage pattern.
Practical -5	Practice on CAD of gating and risering
Practical -6	Experiment to determine the effect of moulding variables in sand moulds
Practical -7	To determine the effect of mould additive on the properties of castings
Practical -8	To determine the characteristics of base sands.

Reference/Text Books:

1. *Welding Technology and Design" by V. M. Radhakrishnan*
2. *"Principles of Metal Casting" by Richard W. Heine, Carl R. Loper Jr., and Philip C. Rosenthal*
3. *"Welding: Principles and Applications" by Larry Jeffus*
4. *"Foundry Technology" by Peter Beeley*
5. *"Metallurgy and Mechanics of Welding" by Regis Blondeau*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Discriminate the knowledge of principles, operations, and applications of different casting and welding processes.	**L2 & L3**
CO-2	Analyze the effects of process parameters on the quality of cast and weld products.	**L3 &L4**
CO-3	Select the NDT techniques for the evaluation of cast and weld components.	**L1& L3**
CO-4	Apply the knowledge of welding in heavy engineering and nuclear industries.	**L2 & L3**
CO-5	Evaluate and mitigate defects in casting and welding processes through appropriate techniques and process adjustments.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Advanced Casting and Welding Technologies Lab (MSPE-112P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Flexible Manufacturing System**
Course Code: MSPE-121	**Title: Flexible Manufacturing System**

Course Objectives:

1. To introduce students to the definition, classification, and need for flexibility in manufacturing systems, and to understand the types of flexibilities and their measurement.
2. To provide knowledge on the factors driving the growth of FMS, its types, applications, and economic justification, along with the functional requirements and equipment used in FMS.
3. To explore the concepts, advantages, and methodologies of group technology, including part family formation, coding, classification, and cell formation methods.
4. To address design, planning, and operational problems in FMS, and to explore methodologies for solving these problems.
5. To impart an understanding of the integration of computer-aided design (CAD), computer-aided manufacturing (CAM), and other advanced technologies in flexible manufacturing systems (FMS).

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** FMS definition and classification of manufacturing systems, Automated production cycle, Need of flexibility, Concept of flexibility, Types of flexibilities and its measurement.	**9L**
II	**FMS Equipment:** Why FMS, Factors responsible for the growth of FMS, FMS types and applications, Economic justification for FMS, Functional requirements for FMS equipments, FMS processing and QA equipment, e.g., turning and machining centers, Co-ordinate measuring machines, Cleaning and deburring machines, FMS system support equipment, Automated material handling and storage equipment, cutting tool and tool management, Work holding considerations, Fixture considerations in FMS environment.	**9L**

III	**Group Technology:** GT concepts, Advantages of GT, Part family formation-coding and classification systems; Part machine group analysis, Methods for cell formation, Use of different algorithms, mathematical programming and graph theoretic model approach for part grouping, Cellular vs FMS production. FMS related problem and Solution **Methodology:** FMS design problems: Part assignment, Machine selection, Storage system selection, Selection of pallets and fixtures, Selection of computer hardware and software, designing for layout integration of machine storage, Material handling System and computer system, Communication networks.	**9L**
IV	**FMS planning problems:** Strategic planning, Part type selection, Machine grouping, production ratio and resource allocation, Machine loading problems.	**9L**
V	**Operational & Control problems:** Part scheduling, Machines robots & AGVS, Process monitoring & control. **FMS Implementation:** Objectives, acceptance testing, Performance goals and expectation maintenance concerns.	**9L**

Reference/ Text Books:

1. Automation, Production System & Computer Integrated Manufacturing Groover Englewood
2. Design and Operation of SMS Rankey IFS
3. Flexible Manufacturing System Wernecks Spring-Verlag
4. FMS in Practice Boncttо Northox Ford
5. Flexible Manufacturing Cells and systems W.W. Luggen Prentice Hall India
6. Performance Modelling of Automated Manufacturing Systems Vishwanathan S.D. Sharma/ Operations Research

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the definition, classification, and necessity of flexibility in manufacturing systems, including the types and measurement of flexibilities.	**L2 & L3**
CO-2	Identify the factors responsible for the growth of FMS, its types, applications, and economic justification, along with the functional requirements for FMS equipment.	**L3 &L4**
CO-3	Apply group technology concepts to form part families, use coding and	**L1& L3**

	classification systems, and employ various methods for cell formation and part grouping.	
CO-4	Analyze and solve FMS design, planning, and operational problems, including part assignment, machine selection, storage system selection, and scheduling.	**L2 & L3**
CO-5	Implement FMS with a focus on strategic planning, production ratios, resource allocation, process monitoring, control, and maintenance.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Flexible Manufacturing System (MSPE-121)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Automation in Manufacturing**
Course Code: MSPE-122	**Title: Automation in Manufacturing**

Course Objectives:
1. Describe the basic concepts of automation in manufacturing systems.
2. Acquire the fundamental concepts of automated flow lines and their analysis.
3. Classify automated material handling, automated storage and retrieval systems.
4. Illustrate adaptive control systems and automated inspection methods
5. Understand the integration and application of robotics in manufacturing automation.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Automation:** Automation in Production Systems- Automated Manufacturing Systems, Computerized Manufacturing Support Systems, Reasons for Automation, Automation Principles and Strategies. Manufacturing operations, Production Concepts and Mathematical Models. Costs of Manufacturing Operations, Basic Elements of an Automated Systems, Advanced Automation Functions, Levels of automation.	**9L**
II	**Introduction to Material Handling**, Overview of Material Handling Equipment, Considerations in Material Handling System Design, The 10 Principles of Material Handling. Material Transport Systems, Automated Guided Vehicle Systems, Monorails and other Rail Guided Vehicles, Conveyor Systems, Analysis of Material Transport Systems. Storage Systems, Storage System Performance, Storage Location Strategies, Conventional Storage Methods and Equipment, Automated Storage Systems, Engineering Analysis of Storage Systems. Automatic data capture-overview of Automatic identification methods, bar code	**9L**

	technology, other ADC technologies.	
III	**Manual Assembly Lines** - Fundamentals of Manual Assembly Lines, Alternative Assembly Systems, Design for Assembly, Analysis of Single Model Assembly Lines, Line balancing problem, largest candidate rule, Kilbridge and Wester method, and Ranked Positional Weights Method, Mixed Model Assembly Lines, Considerations in assembly line design.	**9L**
IV	**Transfer lines, Fundamentals of Automated Production Lines**, Storage Buffers, and Applications of Automated Production Lines. Analysis of Transfer Lines with no Internal Storage, Analysis of Transfer lines with Storage Buffers.	**9L**
V	**Automated Assembly Systems, Fundamentals of Automated Assembly Systems**, Design for Automated Assembly, and Quantitative Analysis of Assembly Systems - Parts Delivery System at Work Stations, Multi- Station Assembly Machines, Single Station Assembly Machines , Partial Automation.	**9L**

Reference/ Text Books:

1. CAD CAM: Principles, Practice and Manufacturing Management / Chris Mc Mohan, Jimmie Browne / Pearson edu. (LPE)
2. Automation, Buckinghsm W, Haper & Row Publishers, New York, 1961
3. Automation for Productivity, Luke H.D, John Wiley & Sons, New York, 1972.
4. Automation, Production systems and computer integrated manufacturing, Mikel P. Groover/Pearson Education.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Illustrate the basic concepts of automation in machine tools.	**L2 & L3**
CO-2	Analyze various automated flow lines, Explain assembly systems and line balancing methods.	**L3 &L4**
CO-3	Describe the importance of automated material handling and storage systems.	**L1& L3**
CO-4	Interpret the importance of adaptive control systems, automated inspection systems.	**L2 & L3**
CO-5	Understand and apply robotics in manufacturing automation and their impact on production efficiency.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Automation in Manufacturing (MSPE-122)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Production & Operations Management**
Course Code: MSPE-123	**Title: Production & Operations Management**

Course Objectives:

1. To develop an understanding of how the operations, have strategic importance and can provide a competitive advantage in the workplace.
2. To understand the relationship between operations and other business functions.
3. To understand techniques of location and facility planning; line balancing; job designing; and capacity plan in operations management.
4. To develop skills in analyzing and improving operational processes for increased efficiency and effectiveness.
5. To apply quantitative and qualitative methods for decision-making in operations management, including forecasting, inventory control, and quality management.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Operation Management** – Definition – Objectives – Types of production systems – historical development of operations management – Current issues in operation management. **Product design** – Requirements of good product design – product development – approaches – concepts in product development – standardization – simplification – Speed to market – Introduction to concurrent engineering.	**9L**
II	**Alue engineering** – objective – types of values – function & cost – product life cycle- steps in value engineering – methodology in value engineers – FAST Diagram – Matrix Method. **Location** – Facility location and layout – Factors considerations in Plant location- Comparative Study of rural and urban sites – Methods of	**9L**

	selection plant layout – objective of good layout – Principles – Types of layout – line balancing.	
III	**Aggregate Planning** – definition – Different Strategies – Various models of Aggregate Planning – Transportation and graphical models. **Advance inventory control systems push systems** – Material Requirement – Terminology – types of demands – inputs to MRP-techniques of MRP – Lot sizing methods – benefits and drawbacks of MRP –Manufacturing Resources Planning (MRP –II), Pull systems – Vs Push system – Just in time (JIT) philosophy Kanban System – Calculation of number of Kanbans Requirements for implementation JIT – JIT Production process – benefits of JIT.	**9L**
IV	**Scheduling** – Policies – Types of scheduling – Forward and Backward Scheduling – Grant Charts – Flow shop Scheduling – n jobs and 2 machines, n jobs and 3 machines – job shop Scheduling – 2 jobs and n machines – Line of Balance.	**9L**
V	**Project Management** – Programming Evaluation Review Techniques (PERT) – three times estimation – critical path – probability of completion of project – critical path method – crashing of simple nature.	**9L**

Reference/ Text Books:

1. Operations Management Theory and Problems - Joseph G. Monks.
2. Production Systems Management - James I. Riggs.
3. Production and Operations Management - Chary.
4. Operations Management - Chase
5. Production and Operation Management - Panner Selvam
6. Production and Operation Analysis – Nahima
7. "Operations Management " by E.S. Buffs

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Identify the elements of operations management and various transformation processes to enhance productivity and competitiveness.	**L2 & L3**
CO-2	Analyze and evaluate various facility alternatives and their capacity decisions, develop a balanced line of production & scheduling and sequencing techniques in	**L3 &L4**

	operation environments.	
CO-3	Develop aggregate capacity plans and MPS in operation environments.	**L1& L3**
CO-4	Plan and implement suitable materials handling principles and practices in the operations.	**L2 & L3**
CO-5	Plan and implement suitable quality control measures in Quality Circles to TQM.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Production And Operations Management (MSPE-123)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Research and Publication Ethics**
Course Code: MSRE-121	**Title: Research and Publication Ethics**

Course Objectives:

1. To understand the importance of philosophy of science and ethics.
2. To identify research misconduct and predatory publications.
3. To understand the open access publications, research metrics.
4. To understand the usage of plagiarism tools.
5. To develop effective scientific communication skills for writing research papers, proposals, and presentations.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Philosophy and Ethics:** Definition of philosophy; nature and scopes; basic concepts; different branches. Define Ethics; moral philosophy; judgements and reactions.	**9L**
II	**Scientific Conduct:** Ethics in science and research; Intellectual honesty and research integrity. Scientific misconducts: Falsification; Fabrication and Plagiarism; Redundant. Publications: duplicate and overlapping publications; Selective reporting and misrepresentation of data.	**9L**
III	**Publication Ethics:** definition; importance; standards setting initiatives and guidelines: COPE, WAME, etc.; Conflicts of interest; Publication misconduct: definition; concept; unethical behavior; types; Violation of publication ethics; authorship and contributor ship; Identification, complaints and appeals for misconduct; Predatory publisher and journals.	**9L**
IV	**Open Access Publishing:** Open access publications and initiatives; SHERPA/RoMEO online resource to check publisher copyright & self-	**9L**

	archiving policies; Software tool to identify predatory publications developed by SPPU - Journal finger / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer, Journal Suggester, etc.	
V	**Publication Misconduct:** Use and importance of plagiarism software like Turnitin, Urkund and other open source software tools.	**9L**

Reference/ Text Books:

1. Nicholas H. Steneck. Introduction to the Responsible Conduct of Research. Office of Research Integrity. 2007. Available at: https://ori.hhs.gov/sites/default/files/rcrintro.pdf
2. The Student's Guide to Research Ethics By Paul Oliver Open University Press, 2003
3. Responsible Conduct of Research By Adil E. Shamoo; David B. Resnik Oxford University Press, 2003
4. Ethics in Science Education, Research and Governance Edited by Kambadur Muralidhar, Amit Ghosh Ashok Kumar Singhvi. Indian National Science Academy, 2019. ISBN : 978-81-939482-1-7.
5. Anderson B.H., Dursaton, and Poole M.: Thesis and assignment writing, Wiley Eastern 1997.
6. Bijorn Gustavii: How to write and illustrate scientific papers? Cambridge University Press.
7. Bordens K.S. and Abbott, B.b.: Research Design and Methods, Mc Graw Hill, 2008.
8. Graziano, A., M., and Raulin, M.,L.: Research Methods – A Process of Inquiry, Sixth Edition, Pearson, 2007.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To understand the fundamental concepts of philosophy and ethics in scientific research.	**L2 & L3**
CO-2	To identify and address various forms of scientific misconduct, including falsification, fabrication, and plagiarism.	**L3 &L4**
CO-3	To apply publication ethics standards and manage conflicts of interest in research and publication.	**L1& L3**
CO-4	To navigate open access publishing and utilize tools to identify predatory publications.	**L2 & L3**
CO-5	To effectively use plagiarism detection software to ensure research integrity and originality.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Research and Publication Ethics (MSRE-121)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Advanced Industrial Engineering**
Course Code: MEPE-121	**Title: Advanced Industrial Engineering**

Course Objectives:

1. To introduce the concept of productivity, factors influencing it, and various approaches to productivity appraisal and analysis within an enterprise.
2. To provide an understanding of work study techniques, including method study, work measurement, time study, and work sampling, to improve standard output.
3. To explore principles of layout and facilities planning, material flow patterns, and material handling systems, along with different types of material handling equipment.
4. To cover fundamental concepts and applications of value engineering and the Function Analysis System Technique.
5. To develop skills in applying productivity improvement strategies, including process optimization and cost reduction techniques, to enhance operational efficiency.

Nature of Paper: Theory (DSE)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Productivity:** Concept, Productivity improvement factors, Productivity appraisal, productivity analysis in the enterprise-The Kurosawa structural approach, Lawlor's approach, Gold's approach, Quick Productivity Appraisal approach (QPA), Inter-Firm Comparison (IFC).	**9L**
II	**Work Design:** Work study, Method study, Work measurement, Standard output, Time study, Work sampling, Process analysis. Facility Layout: Principles of layout and facilities planning,	**9L**
III	**Material flow:** flow patterns, Material handling systems, Types of material handling equipment. **Value Engineering:** Fundamental concepts and applications of value engineering, Function Analysis System Technique.	**9L**

IV	**Systems Engineering:** Introduction to Systems Engineering, Management Information System, Phases in System Engineering, System Life Cycle, System Maintenance.	**9L**
V	**Quality Control:** Understand quality control concepts and definitions. **Systems**: Overview of TQM, Six Sigma, and SPC. **Standards**: Introduction to ISO 9000 and other quality standards. **Tools**: Study tools like Pareto Analysis, Fishbone Diagram, Control Charts, and Histograms.	**9L**

Reference/ Text Books:

1. Prokopenko, J. "Productivity Management, A Practical Handbook", International Labour Organisation, 1992.
2. ILO, "Introduction to Work Study", George Kanawaty, 4th revised edition, Universal Book Corporation 2007.
3. Apple, J.M. "Plant layout and materials handling", Ronald Press Company, New York, 1977.
4. Tutty Herald G, "Compendium on Value Engineering", Indo-American Society, 1983.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the concept of productivity and apply various approaches for productivity improvement and appraisal in an enterprise.	**L2 & L3**
CO-2	Conduct work study techniques such as method study, work measurement, time study, and work sampling to determine standard output.	**L3 &L4**
CO-3	Design effective facility layouts and material handling systems by applying principles of layout and facilities planning.	**L1& L3**
CO-4	Implement value engineering concepts and use the Function Analysis System Technique to optimize product functions and reduce costs.	**L2 & L3**
CO-5	Apply systems engineering principles to manage information systems, understand the system life cycle, and maintain system operations.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Advanced Industrial Engineering (MEPE-121)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Computer Aided Manufacturing**
Course Code: MEPE-122	**Title: Computer Aided Manufacturing**

Course Objectives:

1. Understand the fundamentals of computer-aided programming, including APT programming and NC programming on CAD/CAM systems.
2. Learn about tooling systems for CNC machines, including interchangeable, preset, and modular tooling systems.
3. Explore DNC systems and adaptive control techniques, including their advantages, disadvantages, and applications in machining processes.
4. Gain knowledge of post processors for CNC systems, including their necessity, structure, and functions.
5. Develop skills in microcontrollers and PLCs, including their hardware components, programming, and applications in automation and CNC machines.

Nature of Paper: Theory (DSE)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Computer-Aided Programming:** General information, APT programming, Examples Apt programming probkms (2D machining only). NC programming on CAD/CAM systems, the design and implementation of post processors. Introduction to CAD/CAM software, Automatic Tool Path generation.	9L
II	**Tooling for CNC Machines:** Interchangeable tooling system, preset and qualified toois, coolant fed tooling system, modular fixturing, quick change tooling system, automatic head changers. **DNC Systems and Adaptive Control:** Introduction, type of DNC systems, advantages arid disadvantages of DNC, adaptive control with optimization, Adaptive control with constrains, Adaptive control of	9L

	machining processes like turning, grinding.	
III	**Post Processors for CNC:** Introduction to Post Processors: The necessity of a Post Processor, the general structure of a Post Processor, the functions of a Post Processor, DAPP — based- Post Processor: Communication channels and major variables in the DAPP — based Post Processor, th creation of a DAPP — Based Post Processor.	**9L**
IV	**Micro Controllers:** Introduction, Hardware components, I/O pins, ports, external memory:, counters, timers and serial data I/O interrupts. Selection of Micro Controllers Embedded Controllers, Applications and Programming of Micro Controllers. **Programming Logic Controllers (PLC's):** Introduction, Hardware components of PLC, System, basic structure, principle of operations, Programming mnemonics timers, Internal relays and counters, Applications of PLC's in CNC Machines.	**9L**
V	**Computer Aided Process Planning,** Hybrid CAAP System, Computer Aided Inspection and quality control, Coordinate Measuring Machine, Limitations of CMM, Computer Aided Testing, Optical Inspection Methods, Artificial Intelligence and expert system: Artificial Neural Networks, Artificial Intelligence in CAD, Experts systems and its structures.	**9L**

Reference/ Text Books:

1. Systems approach to Computer Integrated Design and Manufacturing – Nana Singh, John Wiley, 1996.
2. Computer Aided Manufacturing – Tien Chien Chang, Richrad A. Wysk and Hsu-Pin Wang, Pearson Third Editon, 2012.
3. Computer Numerical Control, Operations and Programming – Jon Stenerson, Kelly Cuman, PHI.
4. Computer Control of Manufacturing Systems / Yoram Koren / Mc Graw Hill. 1983. 2. Computer Aided Design Manufacturing – K. Lalit Narayan, K. Mallikarjuna Rao and M.M.M. Sarcar, PHI, 2008.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology	
Category	**Max. Marks**
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Illustrate the principles and applications of computer-aided programming and	**L2 & L3**

	automatic tool path generation.	
CO-2	Describe various tooling systems for CNC machines and their impact on machining efficiency and flexibility.	**L3 &L4**
CO-3	Analyze DNC systems and adaptive control techniques, and apply them to optimize machining processes.	**L1& L3**
CO-4	Understand the role and functionality of post processors in CNC systems and develop basic post-processing solutions.	**L2 & L3**
CO-5	Demonstrate proficiency in programming and applying microcontrollers and PLCs for automation in manufacturing systems.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Computer Aided Manufacturing (MEPE-122)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: I**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Production Engineering Lab**
Course Code: MSPE-124P	**Title: Production Engineering Lab**

Course Objectives:

1. Analyze the morphology of chips produced from different materials and machining processes.
2. Evaluate the mechanical properties of metals through TIG and MIG welding experiments.
3. Measure and interpret tool face temperatures using thermocouple methods.
4. Assess the roughness of machined surfaces and its dependence on tool geometry and feed rate.
5. Study and apply the construction and operational parameters of various machining and extrusion setups.

Nature of Paper: Practical

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 2 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical -1	Study of the morphology of chips produced from different materials sand machining processes.
Practical -2	Experiments on TIG and MIG welding to find out the mechanical properties of metals.
Practical -3	Evaluations of tool face temperature with thermocouple method.
Practical -4	Roughness of machined surface. Influence of tool geometry and feed rate.
Practical -5	Study of the construction and operating parameters of metal spinning Lathe.
Practical -6	Study of the water hammer equipment and hydrostatic extrusion setup.
Practical -7	Extrusion of cylindrical billets through dies of different included angles and exit diameters.
Practical -8	Effect of tool geometry on chip flow direction in simulated orthogonal cutting conditions.
Practical -9	Practice and study of blanking and punching process and their characteristic features

	on mechanical press with existing dies.
Practical -10	Study of cutting ratio/chip thickness ratio in simulated orthogonal cutting with different materials and tool geometry.

Reference/Text Books:

1. ″Manufacturing Engineering and Technology" by Serope Kalpakjian and Steven Schmid
2. "Fundamentals of Machining and Machine Tools" by Geoffrey Boothroyd and Winston A. Knight
3. "Welding: Principles and Applications" by Larry Jeffus
4. "Introduction to Fluid Mechanics" by Robert W. Fox, Alan T. McDonald, and Philip J. Pritchard
5. "Metal Cutting Principles" by David A. Stephenson and John S. Agapiou

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Identify and analyze chip morphology from different machining processes.	**L2 & L3**
CO-2	Evaluate the mechanical properties of welded metals using TIG and MIG techniques.	**L3 &L4**
CO-3	Measure and analyze tool face temperatures in machining operations.	**L1& L3**
CO-4	Understand and assess surface roughness related to tool geometry and feed rates.	**L2 & L3**
CO-5	Operate and analyze various metal spinning, extrusion, and cutting processes, including their effects on material properties and process efficiency.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Production Engineering Lab (MSPE-124P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Simulation, Modelling & Analysis**
Course Code: MEPE-231	**Title: Simulation, Modelling & Analysis**

Course Objectives:
1. Define the basics of simulation modeling and replicating the practical situations in organizations
2. Generate random numbers and random variates using different techniques.
3. Develop simulation model using heuristic methods.
4. Analysis of Simulation models using input analyzer, and output analyzer
5. Explain Verification and Validation of simulation model.

Nature of Paper: Theory (DSE-III)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction: Simulation:** a tool, advantages and disadvantages of simulation, areas of application, systems and system environment, components of a system, discrete and continuous systems, discrete event system simulation. **General Principles:** Concepts in discrete event simulation, time advance algorithm, manual simulation using event scheduling, basis properties and operations.	**9L**
II	**Models In Simulation:** Terminology and concepts, statistical models: queuing systems; inventory systems; reliability and maintainability, limited data, discrete distributions: Bernoulli distribution; Bionomial distribution; Geometric distribution, continuous distribution: Uniform distribution; Exponential distribution; Gamma distribution; Normal distribution; Weibull distribution; Triangular Distribution; Lognormal distribution, poisson process,	**9L**
III	**Queueing Models:** Characteristics of queuing systems, the calling population, system capacity, arrival process, service mechanism, queuing	**9L**

	notations, long run measures of performance of queuing systems, server utilization in G/G/1/∞/∞ queues, server utilization in G/G/C/∞/∞ queues, server utilization and system performance, costs in queuing problems, Larkovian models.	
IV	**Random Number Generation:** Properties of random numbers, Pseudo random numbers, techniques of generating random numbers, tests of random numbers. **Random Variate Generation:** Inverse transforms technique, Direct transformation for the Normal and Lognormal distribution, Convolution Method, Acceptance rejection technique.	**9L**
V	**Input Modelling And Validation:** Steps in the development of model, data collection, Distribution identification, Parameter estimation, Goodness of Fit Tests, selecting input models without data, verification and validation of simulation models.	**9L**

Reference/ Text Books:

1. Simulation Modelling and Analysis by Law and Kelton, Mc Graw Hill.
2. Simulation Model Design& execution by Fishwich, Prentice Hall.
3. Discrete event system simulation by Banks, Carson, Nelson and Nicol.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Describe the role of important elements of discrete event simulation and modeling paradigm.	**L2 & L3**
CO-2	Conceptualize real world situations related to systems development decisions, originating from source requirements and goals.	**L3 &L4**
CO-3	Develop skills to apply simulation software to construct and execute goal-driven system models.	**L1& L3**
CO-4	Interpret the model and apply the results to resolve critical issues in a real world environment.	**L2 & L3**
CO-5	Evaluate and improve system performance through analysis of simulation results and iterative model refinement.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Simulation, Modeling & Analysis (MEPE-231)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Quality Engineering in Manufacturing**
Course Code: MEPE-232	**Title: Quality Engineering in Manufacturing**

Course Objectives:

1. To introduce the overall quality system, including quality engineering in production design and processes, and understanding the economic implications of tightening tolerances.
2. To provide knowledge on functional limits, tolerance design for different characteristics, and parameter design strategies.
3. To teach various analysis of variance (ANOVA) methods and their applications in quality engineering.
4. To explore test strategies using orthogonal arrays and methods for interpreting experimental results.
5. To cover ISO-9000 quality systems, Six Sigma, benchmarking, quality circles, and problem analysis techniques.

Nature of Paper: Theory (DSE)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4 Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4 Credits)

Unit	Contents	No. of Lectures Allotted
I	**Quality Value and Engineering:** An overall quality system, quality engineering in production design, quality engineering in design of production processes. Loss Function and Quality Level: Derivation and use of quadratile loss function, economic consequences of tightening tolerances as a means to improve quality, evaluations and types tolerances.(N-type, S-type and L-type)	**9L**
II	**Tolerance Design and Tolerancing:** Functional limits, tolerance design for N-type. L-type and S-type characteristics, tolerance allocation fbr multiple components. Parameter and Tolerance Design: Introduction to parameter design, signal to noise ratios, Parameter design strategy, some of the case studies on parameter and tolerance designs.	**9L**
III	**Analysis of Variance (ANOVA):** NO-way ANOVA, One-way	**9L**

	ANOVA, Two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.	
IV	**Orthogonal Arrays:** Typical test strategies, better test strategies, efficient test strategies, steps in designing, conducting and analyzing an experiment. Interpolation of Experimental Results: Interpretation methods, percent contributor, estimating the mean.	**9L**
V	**Quality System:** ISO-9000 Quality System, BDRE, 6.-sigma, Bench making, Quality circles Brain Storming — Fishbone diagram — problem analysis.	**9L**

Reference/ Text Books:

1. Taguchi Techniques for Quality Engineering / Phillip J. Ross / McGraw Hill, Intl. II Edition, 1995.
2. Quality Engineering in Production systems I G. Taguchi, A. Elsayed et al / Mc. Graw Hill Intl. Edition, 1989.
3. Taguchi Methods explained: Practical steps to Robust Design / Papan P. Bagchi I Prentice Hall md. Pvt. Ltd., New Delhi.
4. Design of Experiments using the Taguchi Approach/Ranjit K. Roy, John wiley & sons. Inc. 2001.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3)Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand quality value and engineering concepts, including the derivation and application of the quadratic loss function and the economic consequences of improving quality through tightened tolerances.	**L2 & L3**
CO-2	Apply tolerance design techniques for different types of characteristics and perform parameter design using signal-to-noise ratios.	**L3 &L4**
CO-3	Conduct and critique various ANOVA methods, including one-way and two-way ANOVA, and analyze data for multiple level factors.	**L1& L3**
CO-4	Utilize orthogonal arrays for efficient test strategies, design and conduct experiments, and interpret experimental results using different methods.	**L2 & L3**
CO-5	Implement ISO-9000 quality systems, apply Six Sigma principles, and use quality improvement tools such as benchmarking, quality circles, and fishbone diagrams for problem analysis.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1: Remember, L2: Understand, L3 : Apply, L4: Analyze)

CO-PO Mapping
Quality Engineering in Manufacturing (MEPE-232)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Rapid Prototyping Technologies**
Course Code: MEPE-233	**Title: Rapid Prototyping Technologies**

Course Objectives:

1. Understand the fundamentals, historical development, and classification of rapid prototyping processes.
2. Explore and compare various rapid prototyping systems, including liquid-based, solid-based, and powder-based methods, along with their advantages and limitations.
3. Learn about rapid tooling methods, including indirect and direct approaches, and their applications in manufacturing.
4. Analyze rapid prototyping data formats, software tools, and their implications for model accuracy and functionality.
5. Examine the diverse applications of rapid prototyping across industries such as aerospace, automotive, jewelry, medical, and bioengineering.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Prototyping fundamentals, Historical development, Fundamentals of Rapid Prototyping, Advantages and Limitations of Rapid Prototyping, Commonly used Terms, Classification of RP process, Rapid Prototyping Process Chain: Fundamental Automated Processes, Process Chain.	**9L**
II	**Liquid-based Rapid Prototyping Systems:** Stereo lithography Apparatus (SLA): Models and specifications, Process, working principle, photopolymers, photo polymerization, Layering technology, laser and laser scanning, Applications, Advantages and Disadvantages, Case studies. **Solid ground curing (SGC):** Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies	**9L**

	Solid-based Rapid Prototyping Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.	
III	**Powder Based Rapid Prototyping Systems:** Selective laser sintering (SLS): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Three-dimensional Printing (3DP): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. **Rapid Tooling:** Introduction to Rapid Tooling (RT), Conventional Tooling Vs. RT, Need for RT. Rapid Tooling Classification: Indirect Rapid Tooling Methods: Spray Metal Deposition, RTV Epoxy Tools, Ceramic tools, Investment Casting, Spin Casting, Die casting, Sand Casting, 3D Keltool process. Direct Rapid Tooling: Direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.	**9L**
IV	**Rapid Prototyping Data Formats:** STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Rapid Prototyping Software's: Features of various RP software's like Magic's, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor.	**9L**
V	**RP Applications:** Application – Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. **RP Medical and Bioengineering Applications:** Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules.	**9L**

Reference/ Text Books:

1. Rapid prototyping: Principles and Applications - Chua C.K., Leong K.F. and LIM C.S, World Scientific publications , Third Edition, 2010.
2. Rapid Manufacturing – D.T. Pham and S.S. Dimov, Springer, 2001
3. Whalers Report 2000 – Terry Wohlers, Wohlers Associates, 2000 Rapid Prototyping & Manufacturing – Paul F. Jacobs, ASME Press, 1996.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-

3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Generating a good understanding of RP history, its development and applications. Expose the students to different types of Rapid prototyping processes, materials used in RP systems and reverse engineering.	**L2 & L4**
CO-2	Students will be exposed to different types of Rapid prototyping processes, materials used in RP systems and reverse engineering.	**L2 & L3**
CO-3	Students gain knowledge to develop prototypes	**L1& L3**
CO-4	Students learn the concepts of rapid tool processing	**L3 &L4**
CO-5	Apply rapid prototyping techniques to real-world applications in design, engineering, and industry-specific scenarios.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Rapid Prototyping Technologies (MEPE-233)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	3	2	3	1	2	0	0	0	0	0	3
CO-2	2	3	2	3	1	2	0	0	0	0	0	3
CO-3	2	3	2	3	1	2	0	0	0	0	0	3
CO-4	2	3	2	3	1	2	0	0	0	0	0	3
CO-5	2	3	2	3	1	2	0	0	0	0	0	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Finite Element Techniques**
Course Code: MECS-234	**Title: Finite Element Techniques**

Course Objectives:

1. To introduce the fundamental concepts of the Finite Element Method (FEM), including stress, equilibrium, boundary conditions, and strain-displacement relations.
2. To provide knowledge on finite element modeling for one-dimensional problems, trusses, frames, and beams.
3. To explore finite element modeling for two-dimensional stress analysis, including constant strain triangles, isoparametric elements, and axisymmetric solids.
4. To cover steady-state heat transfer, time-dependent field problems, and dynamic analysis using FEM.
5. To develop skills in applying FEM for practical engineering problems, including verification of results and optimization of solutions.

Nature of Paper: Theory (DSE)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L: 4
T: 1
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction to Finite Element Method** of solving field problems. Stress and Equilibrium. Boundary conditions. Strain-Displacement relations. Stress-strain relations. **One Dimensional Problem:** Finite element modeling. Local, natural and global coordinates and shape functions. Potential Energy approach: Assembly of Global stiffness matrix and load vector. Finite element equations, treatment of boundary conditions. Quadratic shape functions.	**9L**
II	**Analysis of trusses and frames**: Analysis of plane truss with number of unknowns not exceeding two at each node. Analysis of frames with two translations and a rotational degree of freedom at each node. Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom	**9L**

	per node for beam element. Solid-based Rapid Prototyping Systems: Laminated Object Manufacturing (LOM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies. Fused Deposition Modeling (FDM): Models and specifications, Process, working principle, Applications, Advantages and Disadvantages, Case studies.	
III	**Finite element modeling of two-dimensional** stress analysis problems with constant strain triangles and treatment of boundary conditions. Two dimensional four noded isoparametric elements and numerical integration. Finite element modeling of Axisymmentric solids subjected of axisymmetric loading with triangular elements. Convergence requirements and geometric isotropy.	**9L**
IV	**Steady state heat transfer analysis**: One dimensional analysis of a fin and two-dimensional conduction analysis of thin plate. Time dependent field problems: Application to one dimensional heat flow in a rod. Dynamic analysis: Formulation of finite element modeling of Eigen value problem for a stepped bar and beam. Evaluation of Eigen values and Eigen vectors. Analysis of a uniform shaft subjected to torsion using Finite Element Analysis	**9L**
V	**Finite element formulation** of three-dimensional problems in stress analysis. Finite Element formulation of an incompressible fluid. Potential flow problems Bending of elastic plates. Introduction to non-linear problems and Finite Element analysis software.	**9L**

Reference/ Text Books:

1. Tirupathi R Chandraputla and Ashok. D. Belegundu, Introduction of Finite Element in Engineering, Prentice Hal of India, 1997.
2. Rao S.S., The Finite Element Methods in Engineering, Pergamon Press, 1989.
3. Segerland. L.J., Applied Finite Element Analysis, Wiley Publication, 1984.
4. Reddy J.N., An Introduction to Finite Element Methods, Mc Graw Hil Company, 1984.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the fundamental concepts of FEM, including stress, equilibrium,	**L2 & L3**

	boundary conditions, and strain-displacement relations.	
CO-2	Model and analyze one-dimensional problems using finite element methods.	**L2 & L4**
CO-3	Perform finite element modeling for two-dimensional stress analysis problems, including constant strain triangles, isoperimetric elements, and axisymmetric solids.	**L1& L3**
CO-4	Analyze steady-state heat transfer, time-dependent field problems using FEM.	**L2 & L3**
CO-5	Formulate and solve three-dimensional problems in stress analysis.	**L3 &L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Finite Element Techniques (MEPE-234)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	2	1	1	2	0	0	0	0	0	1
CO-2	2	3	2	2	2	2	0	0	0	0	0	1
CO-3	3	3	1	2	1	2	0	0	0	0	0	2
CO-4	2	3	2	1	2	1	0	0	0	0	0	2
CO-5	3	2	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.TECH IN PRODUCTION ENGINEERING**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Seminar**
Course Code : MSPE-231P	**Title: Seminar**

Course Objectives:

1. To develop the ability to explore and understand advanced topics in production engineering through literature review and research articles.
2. To enhance students' skills in technical communication through oral presentations and report writing.
3. To encourage independent thinking, critical analysis, and creative approaches in exploring research problems.
4. To improve the ability to summarize and present technical content in a coherent and professional manner.
5. To prepare students for future research or industrial challenges through exposure to current trends and technological advancements.

Nature of Paper: PRACTICAL

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 16 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=2Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
1	**Students Prepare their Project Thesis and present.**	16

Evaluation/Assessment Methodology

Category	Max, Marks
1) Class tasks/ Sessional Examination	-
2) Presentations /Seminar	20
3) Assignments	-
4) Research Project Report Seminar On Research Project Report	20
5) ESE	60

Total:		**100**
Prerequisites for the course:		
Course Learning Outcomes:		
CO-1	Identify and select a relevant research topic from advanced areas of production engineering.	**L2**
CO-2	Conduct an effective literature review to gather and evaluate recent developments related to the chosen topic.	**L3**
CO-3	Analyze and interpret technical content to draw meaningful insights and present logical conclusions.	**L4**
CO-4	Prepare a concise and well-structured technical report in accordance with academic and professional standards.	**L3**
CO-5	Deliver a clear and confident oral presentation with appropriate use of visual aids and communication strategies.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	1	0	0	0	1	2	3
CO-2	3	3	3	2	1	1	0	0	0	1	1	3
CO-3	3	3	3	3	1	0	0	0	0	0	1	3
CO-4	3	3	3	2	2	1	0	0	0	1	2	3
CO-5	3	3	3	3	2	1	0	0	0	0	1	3

Foramt-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech In Production Engineering**	**Year: II** **Semester: III**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Synopsis of Dissertation**
Course Code : MSPE-232P	**Title: Synopsis of Dissertation**

Course Objectives:

1. To guide students in identifying a suitable and relevant research problem in the domain of Production Engineering.
2. To develop the ability to review scientific literature and understand the research gap.
3. To enhance the student's capability in formulating research objectives and methodology.
4. To cultivate skills in technical documentation and formal writing of a research synopsis.
5. To prepare students for initiating independent research with a strong foundation and clear research direction.

Nature of Paper: PRACTICAL

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 16 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=2Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
1	Students Prepare their Project Thesis and present.	**16**

Evaluation/Assessment Methodology

Category	Max, Marks
1) Class tasks/ Sessional Examination	-
2) Presentations /Seminar	30
3) Assignments	-
4) Research Project Report Seminar On Research Project Report	30
5) ESE	90
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:		
CO-1	Identify a research-worthy problem relevant to production engineering.	**L2**
CO-2	Conduct a structured literature review to determine research gaps and define objectives.	**L3**
CO-3	Formulate a research plan, including problem definition, hypothesis, and methodology.	**L4**
CO-4	Prepare a well-structured synopsis document adhering to academic and research guidelines.	**L3**
CO-5	Defend the proposed research work confidently through oral presentation and technical justification.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	3	2	2	1	0	0	0	1	2	3
CO-2	3	3	3	2	1	1	0	0	0	1	1	3
CO-3	3	3	3	3	1	0	0	0	0	0	1	3
CO-4	3	3	3	2	2	1	0	0	0	1	2	3
CO-5	3	3	3	3	2	1	0	0	0	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: PG(R) **Class: M.Tech In Production Engineering**	**Year: II** **Semester: IV**
Credits: 10 **Theory: 0** **Practical: 10**	**Subject: Final Dissertation**
Course Code: MSPE-241P	**Title: Final Dissertation**

Course Objectives:

1. To enable students to identify and formulate engineering problems through literature review.
2. To develop skills in designing experimental or theoretical approaches to solve engineering problems.
3. To enhance technical writing and documentation skills through project reports.
4. To promote teamwork and project management skills.
5. To develop the ability to critically evaluate results and present conclusions effectively.

Nature of Paper: PRACTICAL

Minimum Passing Marks/Credits: 50% Marks / 10 Credits (50% of Internal Assessment & 50% of External Assessment)

L: 0
T: 0
P: 16 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=2Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
1	Students Prepare their Project Thesis and present.	16

Evaluation/Assessment Methodology

Category	Max, Marks
1) Class tasks/ Sessional Examination	-
2) Presentations /Seminar	30
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	30
5) ESE	120
Total:	**200**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Identify and define a real-world engineering problem through critical literature review.	**L2**
CO-2	Apply engineering concepts and tools to develop and implement an effective solution.	**L3**
CO-3	Analyze data, interpret results, and draw logical conclusions based on the research findings.	**L4**
CO-4	Prepare and present a comprehensive dissertation report with proper technical writing and formatting.	**L3**
CO-5	Demonstrate effective communication, teamwork, and project management skills during project execution and presentation.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	3	2	2	1	0	0	0	1	2	3
CO-2	3	3	3	2	1	1	0	0	0	1	1	3
CO-3	3	3	3	3	1	0	0	0	0	0	1	3
CO-4	3	3	3	2	2	1	0	0	0	1	2	3
CO-5	3	3	3	3	2	1	0	0	0	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: PG(R) **Class: M.Tech In Production Engineering**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Comprehensive Viva**
Course Code : MSPE-242P	**Title: Comprehensive Viva**

Course Objectives:
1. To assess the students' overall understanding of core mechanical engineering subjects.
2. To encourage the integration of knowledge acquired from various courses throughout the program.
3. To develop the ability to respond to technical questions with clarity and confidence.
4. To prepare students for real-life engineering interviews and oral examinations.
5. To evaluate the students' problem-solving, analytical, and communication skills.

Nature of Paper: PRACTICAL

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 0
T: 0
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1Credit(4Hrs./Week=2Credits)

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
1	**Comprehensive Viva about their Project.**	-

Evaluation/Assessment Methodology

Category	Max, Marks
1) Class tasks/ Sessional Examination	-
2) Presentations /Seminar	40
3) Assignments	-
4) Research Project Report Seminar On Research Project Report	-
5) ESE	60
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Recall and explain fundamental concepts from core mechanical engineering subjects.	**L2**

CO-2	Demonstrate an integrated understanding of multiple subjects to address viva questions.	**L3**
CO-3	Apply theoretical knowledge to solve interdisciplinary problems posed during the viva.	**L4**
CO-4	Analyze and justify answers logically during technical discussions.	**L3**
CO-5	Communicate technical information clearly and confidently during oral assessments.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping

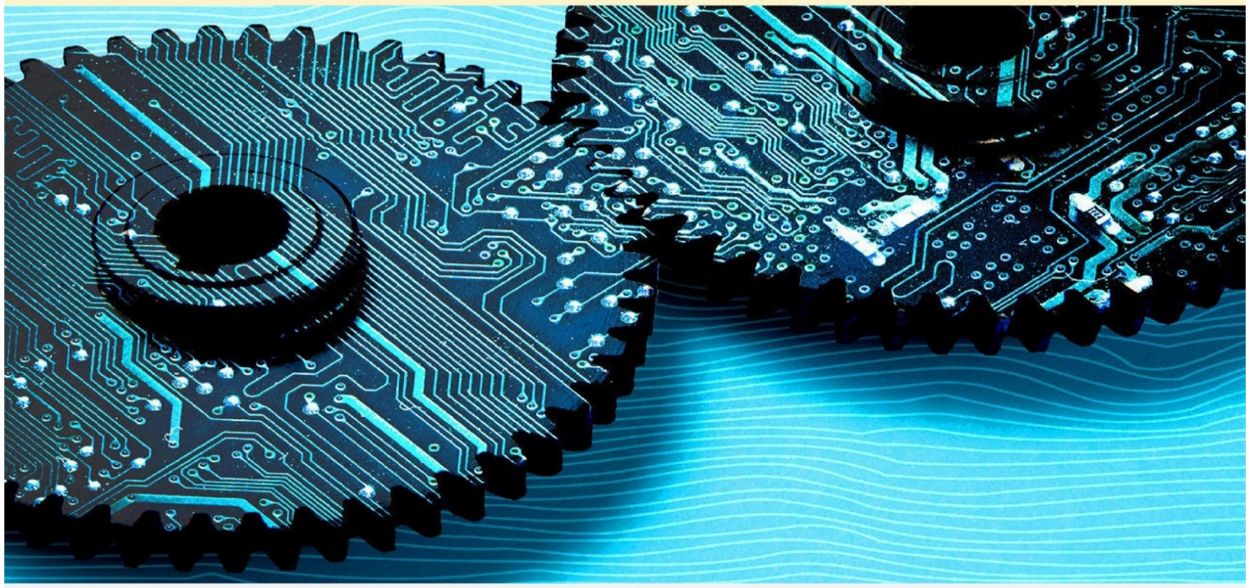
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	0	0	0	1	0	0	0	1	2	1
CO-2	3	3	2	1	0	1	0	0	0	1	1	2
CO-3	3	3	3	2	1	0	0	0	0	0	1	2
CO-4	2	3	2	2	0	1	0	0	0	1	2	2
CO-5	0	0	0	0	0	1	0	0	0	0	1	1

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Evaluation Scheme

Computer Science & Engineering

Evaluation Scheme – Master of Technology (Computer Science & Engineering)
Year: I / Semester: I

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1	MSCS-111	Analysis and Design of Algorithms	Th	Core-1	4	1	-	4	20	10	30	70	100
2	MSCS-112	Advanced Operating System	Th	Core-2	4	1	-	4	20	10	30	70	100
3	MSCS-113	Software Testing & Quality Assurance	Th	Core-3	4	1	-	4	20	10	30	70	100
4	MSRM-111	Research Methodology	Th	Core-4	4	1	-	4	20	10	30	70	100
5	MECS-111/ MECS-114	Departmental Elective Course-I	Th	DSE-1	4	1	-	4	20	10	30	70	100
6	MSCS-111P	Analysis and Design of Algorithms Lab	P	LAB-1	0	0	2	2	10	10	20	30	50
7	NECC-111*	Industrial Visit/ Seminar/ Presentation On The Report Of Visits	P	AC	0	0	0	NC*	0	25*	25*	0	25*
8.	NECC-112*	University Social Responsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**20**	**5**	**2**	**22**	**110**	**60**	**170**	**380**	**550**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, SEC- Skill Enhancement Course, Th- Theory, ESE- End Semester Examination, AC- Audit course

*Note: NECC-111 & NECC-112 are Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies during the semester. Student needs to qualify it but the marks will not be added in total marks

Discipline Specific Electives -I	1. MECS-111 Cyber Security 2. MECS-112 Advance Data Mining Techniques 3. MECS-113 Soft Computing Techniques 4. MECS-114 Agile Based Software Engineering

Evaluation Scheme – Master of Technology (Computer Science & Engineering)
Year: I / Semester: II

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1	MSCS-121	Advanced Computer Network	Th	Core-5	4	1	-	4	20	10	30	70	100
2.	MSCS-122	Advanced Computer Architecture	Th	Core-6	4	1	-	4	20	10	30	70	100
3	MSCS-123	Ad Hoc Wireless Networks	Th	Core-7	4	1	-	4	20	10	30	70	100
4	MSRE-121	Research and Publication Ethics	Th	Core-8	4	1	-	4	20	10	30	70	100
5	MECS-121/ MECS-124	Departmental Elective Course-II	Th	DSE-2	4	1	-	4	20	10	30	70	100
6	MSCS-121P	Advanced Computer Network Lab	P	LAB-2	0	0	2	2	10	10	20	30	50
7	MSEC-121	Short Term Certification in Google Cloud Computing	P	SEC-1	0	0	4	2	30	20	50	-	50
7	*NECC-121	Industrial Visit/ Seminar/ Presentation On The Report Of Visits	P	AC	0	0	0	NC*	0	25*	25*	0	25*
8	*NECC-122	University Social Responsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**20**	**5**	**6**	**24**	**140**	**80**	**220**	**380**	**600**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, DSE- Discipline Specific Elective, Th- Theory, ESE- End Semester Examination, AC- Audit course

*Note: NECC-121 & NECC-122 are Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies during the semester. Student needs to qualify it but the marks will not be added in total marks

Discipline Specific Electives -II	1. MECS-121 Mobile Computing 2. MECS-122 Software Project Management 3. MECS-123 Grid Computing 4. MECS-124 Advance Cryptography

Evaluation Scheme – Master of Technology (Computer Science & Engineering)
Year: II / Semester: III

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1	MECS-231/ MECS-234	Departmental Elective Course-III	Th	DSE-3	4	1	-	4	20	10	30	70	100
2	MECS-235/ MECS-238	Departmental Elective Course-IV	Th	DSE-4	4	1	-	4	20	10	30	70	100
3	MSCS-231P	Seminar	P	RP-1	0	0	5	4			40	60	100
4	MSCS-232P	Synopsis of Dissertation	P	RP-2	0	0	5	4			60	90	150
5	MSEC -231	Short Term Certification in Advance Technology	P	SEC-2	0	0	4	2	30	20	50	-	50
6	*NECC-231	Industrial Visit/ Seminar/Presentation on the report of visits	P	AC	0	0	0	NC*	0	25*	25*	0	25*
7	*NECC-232	University SocialResponsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**8**	**2**	**14**	**18**	**70**	**40**	**210**	**290**	**500**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, DSE- Discipline Specific Elective, Th- Theory, ESE- End Semester Examination, AC- Audit course

*Note: NECC-231 & NECC-232 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies during the semester. Student needs to qualify it but the marks will not be added in total marks.

Discipline Specific Elective-III	1. MECS-231 Internet of Things 2. MECS-232 Cloud Computing 3. MECS-233 Natural Language Computing 4. MECS-234 Malware Analysis Detection & Prevention
Discipline Specific Elective-IV	1, MECS-235 Data Compression 2. MECS-236 Pattern Recognition 3. MECS-237 Intrusion Detection & Prevention 4. MECS-238 Big Data Analytics

Evaluation Scheme – Master of Technology (Computer Science & Engineering)
Year: II / Semester: IV

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	MSCS-241P	Final Dissertation	P	RP-3	0	0	16	10			80	120	200
2.	MSCS-242P	Comprehensive Viva	P	RP-4	0	0	0	4			40	60	100
Total					**0**	**0**	**16**	**14**			**120**	**180**	**300**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, SEC- Skill Enhancement Course, DSE- Discipline Specific Elective, Th- Theory, ESE- End Semester Examination, AECC- Ability Enhancement Compulsory Course, AC- Audit course

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CBCS: Statement of Credit distribution (w.e.f: Session 2024-25)

College/School: School of Engineering & Technology **Programme: M.Tech** **Duration: 4 Semester Annual/Semester: Semester**	**Credit range: 70-80** **(Suggested by** **CBCS Committee)**

Sem.	Credit	Core Course/ Foundation Course Th (8 Core)	Ability Enhancement Compulsory Course (AECC)	Skill Enhancement Course (SEC)	Discipline Specific Elective (DSE)	Generic Elective (GE)	Research Project (RP)	Internship (INT)
I	22	C-1 (4 Credit) C-2 (4 Credit) + P-1 (2 Credit) C-3 (4 Credit) C-4 (4 Credit)			DSE- 1 (4 Credit)			
II	24	C-5 (4 Credit) + P-2 (2 Credit) C-6 (4 Credit) C-7 (4 Credit) C-8 (4 Credit)		SEC-1 (2 Credit)	DSE- 2 (4 Credit)			
III	18			SEC-2 (2 Credit)	DSE- 3 (4 Credit) DSE- 4 (4 Credit)		Seminar (04 Credit) Synopsis of Dissertation (4 Credit)	
IV	14						Comprehensive Viva (4 Credit) Dissertation (10 Credit)	
Total Credits	**78**	8 (Th)*4(Credit) = 32 02 (Pr)*02(Credit) = 04 **Total = 36**		02 (Pr)*2 (Credit) = 04 **Total = 04**	04 (Th)*4 (Credit) = 16 **Total = 16**		04+04 = 08 04+ 10 = 14 **Total = 22**	

***Note: A total of 4 Credits are mandatory to earn from NPTEL/Moocs/Coursera etc. during 2 years of M.Tech Program.**

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Format-3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech (CSE)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Course Name: Analysis and Design of Algorithms**
Course Code: MSCS-111	**Category: Core**

Course Objectives:
1. To understand asymptotic performance of algorithms.
2. To understand the divide and conquer methodology algorithms.
3. To give clear idea on algorithmic design paradigms like Dynamic Programming.
4. To understand greedy method approach.
5. To deal with string matching and approximation.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit,ss Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION:** algorithm design paradigms- motivation, concept of algorithmic efficiency, run time analysis of algorithms, growth of functions, asymptotic notations; growth of functions, asymptotic notations time complexity for iterative function time complexity of recursive function: master's method, iteration method & recursion tree method.	9L
II	**ANALYSIS OF DIVIDE AND CONQUER METHODOLOGY:** Structure & Analysis of divide-and-conquer algorithms: examples-Binary search; Quick sort, Merge sort, Medians and Order Statistics; i^{th} order statistics, Randomized Algorithms –Randomized Quick Sort	9L
III	**ANALYSIS OF DYNAMIC PROGRAMMING METHODOLOGY:** Overview, Difference between dynamic programming and divide and conquer Applications and analysis: Matrix Chain Multiplication, 0/1 Knapsack Problem All-pairs Shortest path in graphs, Longest Common Sub-sequence, Optimal Binary Search Tree.	9L
IV	**ANALYSIS OF GREEDY METHOD:** Overview of the Greedy paradigm, Fractional Knapsack problem, Minimum spanning Trees Single source shortest paths, Task Scheduling Problem, Huffman Coding Algorithm Backtracking: Concepts and N-Queens Problem, Branch and Bound: Concepts and Sum of Subsets Problem.	9L

V	**STRING MATCHING AND APPROXIMATION ALGORITHMS:** Pattern Matching Algorithms: Rabin Karp Algorithm, Knuth Morris Pratt Algorithm, String Matching with Finite Automata Approximation Algorithms- Vertex Cover and Travelling Salesperson Problem, Turing's Halting Problem Theory of NP-Completeness: Introduction to Class-P,NP, NP- Hard & NP-Complete with examples.	**9L**

Text Books:

1. *Cormen et al, "Introduction of Computer Algorithm", Prentice Hall India.*

Reference Books:

1. *Sahni et al, "Fundamentals of Compute Algorithms", Galgotia Publication.*
2. *Internet as a Resource for Reference.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course: Data Structure

Course Outcomes:

CO-1	Demonstrate the performance of algorithms.	**L2 & L4**
CO-2	Explain the Concept of Divide and Conquer method to solve real world problems.	**L2&L3**
CO-3	Demonstrate the Dynamic programming techniques.	**L2& L3**
CO-4	Describe the Concept of Greedy method to solve the real world problems of backtracking	**L2 & L3**
CO-5	Explain the various mathematical concepts and implement the pattern matching algorithms.	**L2& L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Analysis and Design of Algorithms (MSCS-111)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	-	-	-	-	-	-	3
CO-2	3	2	2	3	1	-	-	-	-	-	-	2
CO-3	3	3	2	2	2	-	-	-	-	-	2	3
CO-4	3	3	3	3	2	-	-	-	-	-	-	2
CO-5	3	3	2	2	2	-	-	-	-	-	-	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech (CSE)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Advanced Operating System**
Course Code: MSCS-112	**Title: Advanced Operating System**

Course Objectives:
1. To understand main components of Operating system and their working.
2. To study the operations performed by distributed operating system.
3. To understand the architecture and concept of distributed resource management.
4. To understand the concept of failure recovery and fault tolerance.
5. To study and understand the concept of multiprocessor and database operating systems.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction: Overview, Functions of an Operating System, Design Approaches, Types of Advanced Operating System - Synchronization Mechanisms, Concept of a Process, Concurrent Processes, The Critical Section Problem, Other Synchronization Problems, Language Mechanisms for Synchronization, Axiomatic Verification of Parallel Programs - Process Deadlocks - Preliminaries, Models of Deadlocks, Resources, System State, Necessary and Sufficient conditions for a Deadlock, Systems with Single-Unit Requests, Consumable Resources, Reusable Resources.	**9L**
II	Distributed Operating Systems: Introduction, Issues, Communication Primitives, Inherent Limitations Lamport's Logical Clock; Vector Clock; Causal Ordering; Global State; Cuts; Termination Detection. Distributed Mutual Exclusion, Non-Token Based Algorithms, Lamport's Algorithm - Token-Based Algorithms, Suzuki-Kasami's Broadcast Algorithm, Distributed Deadlock Detection, Issues, Centralized Deadlock-Detection Algorithms - Distributed Deadlock-Detection Algorithms. Agreement Protocols, Classification - Solutions, Applications	**9L**
III	Distributed Resource Management: Distributed File systems, Architecture, Mechanisms, Design Issues, Distributed Shared Memory, Architecture, Algorithm, Protocols - Design Issues. Distributed	**9L**

	Scheduling, Issues, Components, Algorithms**.**	
IV	Failure Recovery and Fault Tolerance: Basic Concepts-Classification of Failures, Basic Approaches to Recovery; Recovery in Concurrent System; Synchronous and Asynchronous Check pointing and Recovery; Check pointing in Distributed Database Systems; Fault Tolerance; Issues - Two-phase and Non-blocking Commit Protocols; Voting Protocols; Dynamic Voting Protocols	**9L**
V	Multiprocessor and Database Operating Systems: Structures, Design Issues, Threads, Process Synchronization, Processor Scheduling, Memory Management, Reliability / Fault Tolerance; Database Operating Systems, Introduction, Concurrency Control, Distributed Database Systems, Concurrency Control Algorithms.	**9L**

Text Books:

1. Silberschatz - Applied Operating System Concepts, Wiley, 2000.
2. Lubemir F Bic and Alan C. Shaw - Operating System Principles, Pearson Education, 2003.

Reference Books:

1. Mukesh Singhal and N. G. Shivaratri, "Advanced Concepts in Operating Systems" McGraw- Hill, 2000.
2. Abraham Silberschatz, Peter B. Galvin, G. Gagne, "Operating System Concepts", Sixth Addison n Wesley Publishing Co., 2003.
3. Andrew S. &Tanenbaum, "Modern Operating Systems", Second Edition, Addison Wesley, 2001.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course: Operating system

Course Learning Outcomes:

CO-1	Explain the concept of operating system and working.	**L2 & L3**
CO-2	Apply the operations performed by distributed operating system	**L3 &L4**
CO-3	Define the architecture and concept of distributed resource management	**L2& L3**
CO-4	Explain the concept of failure recovery and fault tolerance.	**L2 & L3**
CO-5	Describe the concept of multiprocessor and database operating systems.	**L2& L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Advanced Operating System (MSCS-112)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	-	-	1	1	-	-	-	-	-	2
CO-2	3	2	-	-	1	1	1	-	-	-	1	1
CO-3	3	2	1	-	1	-	-	-	1	-	-	2
CO-4	3	2	-	2	1	-	-	-	1	-	-	2
CO-5	3	2	-	-	1	-	-	-	-	-	-	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech (CSE)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Software Testing And Quality Assurance**
Course Code: MSCS-113	**Title: Software Testing And Quality Assurance**

Course Objectives:

1. This course covers the important aspects of software quality. It begins with an overview of what is quality assurance, including definitions for the internal and external views of quality.
2. To learn how to planning a test project, design test cases and data, conduct testing operations, manage software problems and defects, generate a testing report.
3. To understand software test automation problems and solutions.
4. To learn metrics for managing quality assurance and understand capabilities of test tools.
5. Developing test plans to guide the testing stage of the software development lifecycle.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L : 4	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION:** Popular Views. Quality: Professional Views, Software Quality, Total Quality Management, Object-Oriented Development Process.The Clean room Methodology, The Defect Prevention Process, Process Maturity Framework. Quality Standards, SEI Process Quality Capability Maturity Model, The SPR Assessment, Malcolm Baldrige Assessment.	**9L**
II	**FUNDAMENTALS IN MEASUREMENT THEORY:** Definition, Operational Definition, and Measurement, Level of Measurement, Some Basic Measures. Reliability and Validity, Measurement Errors, Assessing Reliability, Correction for Attenuation. Complexity Metrics and Models, Lines of Code, Cyclomatic Complexity, Syntactic Constructs.	**9L**
III	**SOFTWARE QUALITY METRICS OVERVIEW:** Product Quality Metrics, Defect Density Metric, Customer Problems Metric, Customer Satisfaction Metrics. In-Process Quality Metrics, Defect Density During Machine, Testing. Defect Arrival Pattern During Machine Testing, Phase-Based Defect Removal Pattern, Defect Removal Effectiveness. Metrics for Software Maintenance, Fix Backlog and Backlog	**9L**

	Management Index, Fix Response Time and Fix Responsiveness, Percent Delinquent Fixes, Fix Quality.	
IV	**APPLYING THE BASIC QUALITY TOOLS IN SOFTWARE DEVELOPMENT**: Ishikawa's Seven Basic Tools, Checklist, Pareto Diagram, Histogram, Run Charts, Scatter Diagram, Control Chart. Cause-and-Effect Diagram, Relations Diagram, Defect Removal Effectiveness and Quality Planning. Phase-Based Defect Removal Model, Cost Effectiveness of Phase Defect Removal, Defect Removal Effectiveness and Process Maturity Level.	**9L**
V	**TESTING OBJECTIVES AND ISSUES OF TESTING:** Testing activities and levels, White-Box and Black-Box Testing, Test Planning and Design. Unit Testing, Data flow testing, functional testing, system testing, In-Process Metrics for Software Testing. Testing Defect Arrivals Over Time, Testing Defect Backlog Over Time. In-Process Metrics and Quality Management, Case Studies.	**9L**

Text Books:

1. Stephen H. Kan, "Metrics and Models in Software

Reference Books:

1. Sagar Naikand Piyu Tripathy, "Software Testing and Quality Assurance: Theory and Practice", Wiley.
2. Paul C. Jorgensen, "Software Testing - A Craftsman's Approach", CRC Press.
3. Internet as a Resource for Reference

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations/Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course: Basic Understanding of Software Development Process

Course Learning Outcomes:

CO-1	Define the concepts of quality and its models	**L2 & L3**
CO-2	Identify and apply various software metrics, which determines the quality level of software	**L3 &L4**
CO-3	Apply and evaluate appropriate processes and tools to troubleshoot issues related to quality assurance.	**L1& L3**
CO-4	Value the role of testing in quality assurance and apply several appropriate testing techniques to software development projects.	**L2 & L3**
CO-5	Choose Software quality measurements and metrics to improve quality	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Software Testing And Quality Assurance (MSCS-113)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	-	3	-	-	-	-	3	3	-	-	-
CO-2	3	1	2	-	-	2	3	3	3	3	-	-
CO-3	3	1	2	1	1	2	2	3	3	3	-	-
CO-4	3	1	2	-	1	-	3	3	3	3	-	-
CO-5	3	-	2	1	-	2	2	3	3	3	-	-

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech (CSE)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Research Methodology**
Course Code: MSRM-111	**Title: Research Methodology**

Course Objectives:
1. To introduce with Research Methodology and its importance.
2. To study the concept of research design.
3. To determination of data collection, analysis, and their interpretation.
4. To know the types of research reports and plagiarism.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction;** Meaning of Research; Objectives; Types; Approaches Adopted in research; Significance; Methodology; different Criteria of Research; and Challenges Faced by Researchers in India; Definition and selection of the Research Problem; Importance of literature review.	9L
II	**Research Design:** Meaning; Methods of research design; Important Concepts Relating to Research Design, Types; and Basic Principles of Designs.	9L
III	**Design of Sampling:** Introduction; Sampling techniques; Errors; Sample Survey; Types of Sampling. **Data Collection:** Types of Data, Classifications of Measurement Scales, Error in Measurement Tools, Scaling, Scaling Technics, Deciding the Scale; Collection of data; Methods of Data Collection.	9L
IV	**Testing of Hypotheses:** Basic Concepts; Hypothesis Testing; Statistics and Critical Region; Procedure for Hypothesis Testing, Limitations; Interpretation of results.	9L
V	**Interpretation and Report Writing:** Introduction; Methods of Interpretation; Precaution; Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and	9L

	referencing styles, Research Journals, Indexing and citation of Journals, Intellectual property, Plagiarism.	

Reference/ Text Books:

1. C. R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques, New Age International publishers, Third Edition.
2. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition, SAGE, 2005.
3. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition.
4. Creswell, John W. Research design: Qualitative, quantitative, and mixed methods approach. Sage publications, 2013.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Discuss the importance of the research methodology and its technique.	**L2 & L3**
CO-2	Understand the importance of literature review in research.	**L3 &L4**
CO-3	Use different methods of research design and data collections.	**L1& L3**
CO-4	Understand the several parametric tests of hypotheses.	**L2 & L3**
CO-5	To evaluate the problems and set hypotheses.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Advanced Analysis of Structures (MSSE-111)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M. Tech (CSE)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Cyber Security**
Course Code: MECS-111	**Title: Cyber Security**

Course Objectives:
The objectives of this course is to teach the students:

1. Learn about information systems, its types, threats, security issues related to it and also about cyber security and risk associated to it
2. Learn about Application security, Data security and types of security Threats in network.
3. Understand the importance of secure information system and risk management issues in different applications.
4. Design security procedures, policies and also implement cryptography in their live projects and also learn about modern copyright, patent law, skills of ethics, cyber-crime and IT ACT.
5. Understand modern copyright, patent law, skills of ethics, cyber-crime and IT ACT so that they can protect their inventions by making use of these Laws.

Nature of Paper: DSE (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to information systems: Types of information Systems, Development of Information Systems, Introduction to information security, Need for Information security, Threats to Information Systems, Information Assurance, Cyber Security, and Security Risk Analysis.	9L
II	Cyber Security Vulnerabilities and Cyber Security Safeguards: Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards-Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.	9L
III	Intrusion Detection and Prevention: Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection,	9L

	Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.	
IV	Cryptography and Network Security: Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls- Types of Firewalls, User Management, VPN Security Protocols: - security at the Application Layer- PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec.	**9L**
V	Cyberspace and the Law: Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013.	**9L**

Text Books:

1. Dr. Surya Prakash Tripathi, Ritendra Goyal, Praveen kumar Shukla,"Introduction to Information Security and Cyber Law" Willey Dreamtech Press.
2. Schou, Shoemaker, "Information Assurance for the Enterprise", Tata McGraw Hill.

Reference Books:

1. CHANDER, HARISH," Cyber Laws And It Protection " , PHI Learning Private Limited ,Delhi ,India

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course: Bachelor degree in computer science & Engineering.

Course Learning Outcomes:

CO-1	To Identify/introduce the Information system & its types.	**L2 & L3**
CO-2	To know Cyber Security Vulnerabilities and Cyber Security Safeguards.	**L3 &L4**
CO-3	To conceptualize the cyber security threats and its prevention.	**L1& L3**
CO-4	To apply & analyze cryptographic techniques.	**L2 & L3**
CO-5	To become familiar with feature knowledge that can be extracted from available examples and generalize to form appropriate feature models.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Cyber Security (MECS-111)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	3	3	3	3	3	1	1	1	3
CO-2	3	3	2	2	2	3	1	3	1	1	1	3
CO-3	3	2	3	2	2	3	1	3	1	1	1	3
CO-4	3	3	2	3	2	3	1	3	1	1	1	3
CO-5	2	2	2	2	2	2	3	3	2	1	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech (CSE**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Advance Data Mining Techniques**
Course Code: MECS-112	**Title: Advance Data Mining Techniques**

Course Objectives:

1. Learn about the most advance data mining methods to solve real world problems.
2. Data Pre-processing, Exploratory Data Analysis, Data Selection, and Knowledge Discovery.
3. This course will introduce the concepts of data ware house and data mining, which gives a complete description about the principles, used, architectures, applications.
4. Data mining has opened a world of possibilities for business.

Nature of Paper: DSE (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=3Credits)

Unit	Contents	No. of Lectures Allotted
I	**DATA MINING OVERVIEW AND ADVANCED PATTERN MINING:** Data mining tasks –mining frequent patterns, associations and correlations, classification and regression for predictive analysis, cluster analysis, outlier analysis. Advanced pattern mining in multilevel, multidimensional space – mining multilevel associations, mining multidimensional associations. Mining quantitative association rules, mining rare patterns and negative patterns.	**9L**
II	**ADVANCE CLASSIFICATION:** Classification by back propagation, support vector machines, Classification using frequent patterns, Other classification methods – genetic algorithms roughest approach, fuzzy set approach;	**9L**
III	**ADVANCE CLUSTERING:** Density - based methods –DBSCAN, OPTICS, DENCLUE; Grid-Based methods – STING, CLIQUE; Exception – maximization algorithm. Clustering High-Dimensional Data; Clustering Graph and Network Data.	**9L**
IV	**WEB AND TEXT MINING:** Introduction to web mining, web content mining, web structure mining, web usage mining, Text mining – unstructured text, episode rule discovery for texts. Hierarchy of categories, text clustering.	**9L**

V	**BIG DATA:** Introduction to Big Data, challenges of conventional systems, Overview of Hadoop, Hadoop Distributed File System (HDFS). Hadoop Map reduce Framework, HBASE. Interacting HDFS using HIVE, sample programs in HIVE-PIG.	**9L**

Text Books:

1. *Data Mining Concepts and Techniques, Jiawei Hang Micheline Kamber, Jianpei, Morgan Kaufmannn.*
2. *Bill Franks, "Taming the big data tidal wave: finding opportunities in huge data streams with advanced analytics", John Wiley & Sons, 2012.*

Reference Books:

1. *Introduction to Data Mining – Pang-Ning Tan, Vipinkumar, Michael Steinbach, Pearson.*
2. *Data Mining Principles & Applications – T.V Sveresh Kumar, B.Esware Reddy, Jagadish S Kalimani, Elsevier.*
3. *Internet as source of reference.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course: Basic knowledge of Programming Language

Course Outcomes:

CO-1	Understand the practical and theoretical concept of data mining and its applications.	**L2 & L3**
CO-2	Extend classification techniques.	**L3 &L4**
CO-3	Illustrate the clustering Techniques & enhancement.	**L1& L3**
CO-4	Explain the concepts of Web and Text Mining.	**L2 & L3**
CO-5	Make use of concept of Big Data analysis.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Advance Data Mining Techniques (MECS-112)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	-	-	-	-	-	-	-	-	-	-	-
CO-2	3	2	-	-	-	-	-	-	-	-	-	-
CO-3	3	-	-	-	-	-	-	-	-	-	-	-
CO-4	3	2	2	-	-	-	-	2	-	3	-	-
CO-5	3	2	2	-	-	-	-	2	-	-	-	-

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech (CSE)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Soft Computing Techniques**
Course Code: MECS-113	**Title: Soft Computing Techniques**

Course Objectives:

1. To conceptualize the working of human brain using ANN.
2. To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems.
3. To introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience.
4. To provide the mathematical background for carrying out the optimization and familiarizing genetic algorithm for seeking global optimum in self-learning situation.

Nature of Paper: DSE (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**NEURAL NETWORK:** History, overview of biological Neuro-system, Mathematical Models of Neurons, architecture, Learning rules, Training rules, Delta, Back Propagation Algorithm. Learning Paradigms-Supervised, Unsupervised and reinforcement Learning, ANN training Algorithms-perceptions. Multilayer Perceptron Model, Hopfield Networks, Associative Memories, Applications of Artificial Neural Networks.	9L
II	**FUZZY LOGIC:** Introduction to Fuzzy Logic, Classical and Fuzzy Sets: Overview of Classical Sets, Membership Function, Fuzzy rule generation, Operations on Fuzzy Sets: Compliment, Intersections, Unions, Combinations of Operations, Aggregation Operations.	9L
III	**FUZZY ARITHMETIC:** Fuzzy Numbers, Linguistic Variables, Arithmetic Operations on Intervals & Numbers, Lattice of Fuzzy Numbers, Fuzzy Equations. Fuzzy Logic: Classical Logic, Multi-valued Logics, Fuzzy Propositions. Fuzzy Qualifiers, Linguistic Hedges.	9L
IV	**UNCERTAINTY BASED INFORMATION:** Information & Uncertainty, Non-specificity of Fuzzy & Crisp Sets, Fuzziness of Fuzzy Sets. Introduction of Neuro-Fuzzy Systems.	9L

V	**Architecture of Neuro fuzzy Networks:** Application of Fuzzy Logic: Medicine, Economics etc. Genetic Algorithm: An Overview. GA in problem solving, Implementation of GA.	**9L**

Text Books:
1. S.N. Sivanandam, "Principles of Soft Computing", John Wiley-
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", PHI.

Reference Books:
1. Anderson J.A., "An Introduction to Neural Networks", PHI.
2. G.J. Klir and B. Yuan "Fuzzy Sets & Fuzzy Logic", PHI.
3. Internet as a resource for referencs.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course: Proficiency with Algorithms.

Course Outcomes:

CO-1	Identify basic mathematical/statistical methods used in soft computing.	**L2 & L3**
CO-2	Formulate learning techniques used in different cases.	**L3 &L4**
CO-3	Use fuzzy logic inference with emphasis on their use in the design of intelligent or humanistic systems.	**L1& L3**
CO-4	Analyze problems involving ambiguities, uncertainties, vagueness and inexactness.	**L2 & L3**
CO-5	Integrate optimization techniques in problems of Engineering and Technology using genetic algorithm.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Soft Computing Techniques(MECS-113)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	1	3	2	2	2	3	2	3	3	2	-	-
CO-2	2	3	2	2	3	2	3	3	3	2	-	-
CO-3	1	2	3	3	3	2	2	3	3	3	-	-
CO-4	1	2	2	3	3	3	2	2	3	3	-	-
CO-5	2	2	3	3	3	3	2	3	3	3	-	-

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech (CSE)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Agile Based Software Engineering**
Course Code: MECS-114	**Title: Agile Based Software Engineering**

Course Objectives:

1. (TDD), pair programming, and refactoring to improve code quality and project **Understand Agile Principles:** Grasp the fundamental principles and values of Agile methodologies, including the Agile Manifesto, to foster a mindset conducive to Agile practices.
2. **Implement Agile Frameworks:** Gain proficiency in various Agile frameworks such as Scrum, Kanban, and Extreme Programming (XP), and understand their practical applications in software development.
3. **Develop Agile Artifacts:** Learn to create and manage Agile artifacts such as user stories, backlogs, sprints, and task boards, ensuring efficient project tracking and delivery.
4. **Facilitate Agile Teams:** Understand the roles and responsibilities within an Agile team, including Scrum Master, Product Owner, and Development Team, and learn techniques for effective team collaboration and communication.
5. **Apply Agile Practices:** Implement key Agile practices such as continuous integration, test-driven development outcomes.

Nature of Paper: DSE (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**AGILE FUNDAMENTALS:-**Overview of traditional software life cycle models. Problems with the waterfall. Rapid software development. Introduction to Agile. History of Agile: More or less a process?. Necessity & requirement of Agility in software development. Agile Manifesto & Principles. Benefits, characteristics and Challenges of Agile methodology. Suitability of Agile Methods: When to Use Agile and When NOT to? Agile misconceptions, Agile hype, Applications of Agile Software development. Agile Lifecycle. Concept of Agile Alliance.	9L
II	**AGILE DEVELOPMENT:-** Iterative development Process, Risk-Driven and Client Driven iterative planning, Time boxed iterative development. Incremental development, Software prototyping: Process, benefits, throw-away prototypes. Conflicting objectives of Incremental	9L

	development and throw-away prototypes. Evolutionary and adaptive development. Classification of different Agile Methods.	
III	**SCRUM:-** SCRUM Roots, Philosophy behind Scrum, Scrum overview, Key Features, Scrum Values, Scrum Lifecycle, Scrum Events-Sprint, Sprint Planning, Daily Scrum, Sprint Review, Sprint Retrospective, Scrum Meetings, Strengths and Weaknesses, Characteristics, Pros and cons, Tools and Techniques, Scrum artifacts, Scrum practices, Work products, Roles, Responsibilities, Common mistakes and misunderstandings, Adoption strategies.	**9L**
IV	**XP(EXTREME PROGRAMMING):-** Method overview , Core values of XP, XP practices, XP Lifecycle, XP and agile principles, Work products Roles and Responsilities, Strengths and Weaknesses, Characteristics, Pros and cons, Tools and Techniques Common mistakes and misunderstandings, Adoption strategies, Scrum vs. XP, Testing in XP, Pair Programming.	**9L**
V	**AGILE TESTING:-** Concept of agile testing, Roles and activities on an Agile Team, Traditional vs. Agile testing, Concept of WholeTeam Approach Role of Tester in Agile Team, Ten Principles for Agile testers, Six concrete practices for testing on agile teams. Organizational and cultural challenges affect tester's role on agile team Agile testing methods-TDD, ATDD, BDD, Exploratory. Agile Testing Lifecycle, Test Plan for Agile. Agile testing Quadrants.	**9L**

Text Books:

1. Agile Testing: A Practical Guide for Testers and Agile Teams 2.
2. Agile and Iterative Development: A Manager's Guide By Craig Larman.

Reference Books:

1. Succeeding with Agile: Software Development Using Scrum .
2. Agile Software Engineering By Orit Hazzan, Yael Dubinsky.
3. Internet resources

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course: Basic knowledge of Software engineering.

Course Learning Outcomes:

CO-1	Demonstrate the ability to participate effectively in agile practices/process for	**L2 & L3**

	software development.	
CO-2	Analyze best and effective Agile Development model required for Software Project Development.	**L3 &L4**
CO-3	Apply Scrum &XP practices to projects.	**L1& L3**
CO-4	Compare agile software development to traditional software development models.	**L2 & L3**
CO-5	Test application for feature testing, integration testing, TDD and BDD testing methods.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Agile based software Engineering (MECS-114)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	2	0	1	0	3	2	3	0	1	2
CO-2	3	3	2	0	2	0	3	3	3	0	1	2
CO-3	3	0	3	3	2	3	3	3	3	0	1	2
CO-4	2	3	2	0	0	0	3	2	3	0	0	1
CO-5	3	2	2	2	3	3	3	3	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech (CSE)**	**Year: I** **Semester: I**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Analysis and Design of Algorithms Lab**
Course Code: MSCS-111P	**Title: Analysis and Design of Algorithms Lab**

Course Objectives:
1. To teach techniques for effective problem solving in computing.
2. The use of different paradigms of problem solving will be used to illustrate clever and efficient ways to solve a given problem.
3. In each case emphasis will be placed on rigorously proving correctness of the algorithm.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Write a program to search an element in the array using Binary search determine the time required to search the element.
Practical-2.	Write a program to sort given set of numbers in ascending/descending order using Quick Sort and determine the time required to sort the elements.
Practical-3.	Write a program to sort given set of numbers in ascending/descending order using Merge Sort and determine the time required to sort the elements.
Practical-4.	Write a program to implement Task Scheduling problem.
Practical-5.	Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.
Practical-6.	Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm.
Practical-7.	Implement All-Pairs Shortest Paths Problem using Floyd's algorithm.
Practical-8.	Write a program to implement Matrix chain multiplication.
Practical-9.	Write a program to demonstrate concept of 0 – 1 Knapsack Problem
Practical-10.	Write a program to implement fractional Knapsack problem.
Practical-11.	From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.
Practical-12.	Write a program to implement Rabin Karp Algorithm problem.

Text Books:
1. Cormen et al, "Introduction of Computer Algorithm", Prentice Hall India.

Reference Books:
1. Sahni et al, "Fundamentals of Compute Algorithms", Galgotia Publication.
2. Internet as a Resource for Reference.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		10
3) External Practical Assessment	External Assessment	15
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Analyze the asymptotic performance of algorithms	**L3 & L4**
CO-2	Describe the dynamic-programming and Greedy paradigm and explain when an algorithmic design situation calls for it.	**L2 &L3**
CO-3	Apply important algorithmic design paradigms and methods of analysis	**L2& L3**
CO-4	Discuss NP-complete problems and develop algorithms to solve the problems.	**L2 & L3**
CO-5	Choose appropriate algorithm design techniques for solving problems.	**L1 & L2**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Analysis and Design of Algorithms Lab (MSCS-111P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	1	3	-	-	1	2	-	-	2	2
CO-2	2	3	2	-	-	-	2	2	-	-	1	1
CO-3	2	3	3	3	-	-	-	-	2	1	1	2
CO-4	3	1	2	2	-	-	2	-	2	3	3	-
CO-5	2	3	3	1	-	2	1	1	2	1	2	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech (CSE)**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Advanced Computer Network**
Course Code: MSCS-121	**Title: Advanced Computer Network**

Course Objectives:

1. **Understanding Advanced Networking Protocols**: Develop a deep understanding of advanced networking protocols, including IPv6, BGP, MPLS, and advanced routing algorithms, to enhance network efficiency and reliability.
2. **Network Security and Management**: Gain expertise in network security principles and practices, such as intrusion detection and prevention, secure network design, and the use of firewalls and VPNs to protect network infrastructure.
3. **Network Performance Optimization**: Learn techniques for optimizing network performance, including traffic engineering, Quality of Service (QoS) implementation, and network monitoring tools to ensure high availability and low latency.
4. **Emerging Networking Technologies**: Explore emerging networking technologies such as Software-Defined Networking (SDN), Network Function Virtualization (NFV), and Internet of Things (IoT) to understand their impact on modern network architectures.
5. **Hands-on Network Design and Implementation**: Engage in practical, hands-on projects that involve designing, implementing, and troubleshooting complex network systems, enabling students to apply theoretical knowledge to real-world scenarios.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**OVERVIEW OF WIRED AND WIRELESS DATA NETWORKS:** Review of Layered Network Architecture, ISO-OSI and TCP/IP Network Model Datagram Networks and Virtual Circuit Networks, Point to Point and Point to Multipoint Networks Layer 2 Switches , IEEE 802.3U (Fast Ethernet) and IEEE 802.3Z (Gigabit Ethernet) Virtual LAN Wireless LAN: IEEE 802.11, Bluetooth Broadband Wireless LAN: 802.16, WIMAX.	**9L**
II	**INTERNETWORKING:** Review of IP Addressing and Routing Internet Architecture: Layers 3 Switch, Edge Router and Core Router Overview of Control Plane, Data Plane ,Management, Internet Routing Protocols:	**9L**

	OSPF, BGP Broadcast and Multicast Routing: Flooding, Reverse Path Forwarding, Pruning, Core based trees, PIM, Mobility Issues and Mobile IP.	
III	**TRANSPORT LAYER PROTOCOLS:** Process to Process Delivery, Review of UDP, TCP, SCTP Protocol: Services, Features, Packet Format, Association, Error Control Wireless TCP and RTP, RTCP, Real Time Application: Voice and Video over IP.	**9L**
IV	**TRAFFIC CONTROL AND QUALITY OF SERVICE:** Flow Control: Flow Model, Open Loop: Rate Control, LBAP, Closed Loop: Window scheme, TCP and SCTP Flow Control. Congestion Control: Congestion Control in packet networks, ECN and RED Algorithm, TCP and SCTP Congestion Control Quality of Service: IP Traffic Models, Classes and Subclasses, Scheduling: GPS, WRR, DRR, WFQ, PGPS, VC.	**9L**
V	**TRAFFIC MANAGEMENT & SECURITY:** Traffic Management Framework: Scheduling, Renegotiation, Signaling, Admission Control, Capacity Planning, Security Issues, Symmetric Encryption: DES, Triple DES, Modes, AES, Public Key Encryption: RSA, Diffie Hellman, Elliptic Curve, Hashing: MDS, SHA-1, DSA Protocols: Kerberos, SSL/TLS, IP Sec.	**9L**

Text Books:
1. Srinivasan Keshav "An Engineering Approach To Computer Networking", Pearson.
2. A.Tanenenbaum, "Computer Network", PHI.

Reference Books:
1. W. Richard Stevens "TCP/IP Illustrated "- Pearson.
2. W. Stallings, "Wireless Communication and Networks" Pearson.
3. Internet as source of Reference.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course: Basic knowledge of computer network.

Course Learning Outcomes:

CO-1	Enumerate the layers of the OSI model and TCP/IP and classifying the function(s) of each layer and understanding IEEE 802.11 AND IEEE 802.3.	**L2 & L3**

CO-2	Develop and build the skills of IP Addressing and Routing with Internet Routing Protocols and summarizing Mobility Issues.	**L3 &L4**
CO-3	Explain the protocols of computer networks like UDP and TCP.	**L1& L3**
CO-4	Illustrate the issues related to the congestion control, flow control and QoS parameters.	**L2 & L3**
CO-5	Demonstrate the traffic management and its issues.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Advanced Computer Network (MSCS-121)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	3	0	0	1	0	2	0	0	2	2
CO-2	3	2	3	0	0	1	0	2	0	0	1	2
CO-3	3	2	3	1	0	0	0	2	0	0	1	2
CO-4	3	2	3	1	2	1	2	2	0	0	1	1
CO-5	3	2	3	2	2	1	2	2	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech (CSE)**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Advanced Computer Architecture**
Course Code: MSCS-122	**Title: Advanced Computer Architecture**

Course Objectives:
The Student will Learn:

- Understand the micro-architectural design of processors.
- Learn about the various techniques used to obtain performance improvement.
- Learn about the various techniques used to obtain power savings in current processor.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Parallel computer models:** The state of computing, Classification of parallel computers, Multiprocessors and Multi computers, Multi vector and SIMD computers. Conditions of parallelism, Program partitioning and scheduling, Program flow mechanisms	9L
II	**Program and network properties and Principles of Scalable Performance:**, System Interconnect Architectures. Performance Metrics and Measures, Parallel processing applications, speedup performance laws, scalability analysis and approaches.	9L
III	**Processors and Memory Hierarchy:** Advanced processor technology, Superscalar and Vector Processors, Vector processing principles, Memory hierarchy technology, virtual memory technology.	9L
IV	**Pipelining & Superscalar Techniques:** Linear pipeline processor, nonlinear pipeline processor, Instruction pipeline Design, Arithmetic Pipeline Design, Superscalar and Super pipe line design.	9L
V	**Parallel & Scalable architectures:** Multiprocessor system Interconnects, Cache coherence and synchronization mechanisms, message passing mechanisms, latency hiding techniques, principles of multithreading, scalable and multithreaded architecture	9L

Reference / Text Books:

1. Kai Hwang, "Advanced computer architecture"; TMH. 2000
2. J.P. Hayes, "Computer Architecture and organization"; MGH. 1998
3. V. Rajaranam & C.S.R. Murthy, "Parallel computer"; PHI. 2002
4. Stalling W, "Computer Organisation & Architecture", PHI. 2000
5. M.J Flynn, "Computer Architecture, Pipelined and Parallel Processor Design"; Narosa Publishing. 1998 5. Hwang and Briggs, "Computer Architecture and Parallel Processing"; MGH.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course: Computer Organization and Architecture

Course Outcomes:

CO-1	Compare and contrast among different parallel computer models.	**L3 & L4**
CO-2	Apply the different Principles of Scalable Performance of parallel computers	**L2 &L3**
CO-3	Describe different Processors technologies and Memory Hierarchy.	**L1& L2**
CO-4	Explain Pipelining & Superscalar Techniques.	**L2 & L3**
CO-5	Explain Parallel & Scalable architectures and their communication	**L2& L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Advanced Computer Architecture (MSCS-122)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	3	2	1	2	1	-	-	-	1	-	1
CO-2	3	2	2	2	2	2	-	-	1	2	-	2
CO-3	2	1	2	1	1	1	-	-	1	1	1	2
CO-4	2	3	2	3	2	2	-	-	2	1	1	2
CO-5	3	3	2	2	2	3	-	-	2	3	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech (CSE)**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Ad Hoc Wireless Networks**
Course Code: MSCS-123	**Title: Ad Hoc Wireless Networks**

Course Objectives:
This course will enable students to
1. Understand the fundamental principles of Ad-hoc Networks and protocols.
2. Study the current and emerging trends in Ad-hoc Wireless Networks.
3. Analyze energy management in ad-hoc wireless networks
4. To understand the Transport layer and its protocols.
5. Interpret the different types of MAC protocols.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Cellular and Ad-hoc Wireless Networks, Applications of Ad-hoc Wireless Networks, Issues in Ad-Hoc Wireless Networks-Medium Access scheme, security, Energy Management, Deployment considerations.	9L
II	**MAC Protocols:** Introduction to Mac, Issues in Designing a MAC Protocol for Ad-HOC Wireless Networks, Classifications of MAC protocols-Contention based protocols, Contention based protocols with reservation mechanisms, Contention based MAC protocols with scheduling Mechanisms, Other MAC protocols-Multi Channel MAC protocol, Power Control MAC protocol for Ad- Hoc Networks.	9L
III	**Routing Protocol:** Issues in Designing a Routing Protocol for Ad- Hoc Wireless Networks-Mobility, Hidden and Exposed terminal Problems, Characteristics of an Ideal Routing Protocol for Ad Hoc Wireless Networks, Classifications of Routing Protocols-Based on Routing Information, Routing Topology, Utilization of Specific resources, Hierarchical Routing Protocol, Power aware Routing Protocol, Multicast Routing-Introduction, Issues in Multicast Routing Protocols, classification: Tree Based Multicast Routing protocol, Mesh Based Multicast Routing protocol.	9L

IV	**Ad Hoc Transport Layer Protocols:** Ad hoc transport layer Issues, Design Goals and Classification of Transport layer Protocol, TCP over Ad-hoc Wireless Networks-Feedback Based TCP, TCP with Explicit Link Failure Notification, TCP-Bus, Ad-hoc TCP and Split TCP.	**9L**
V	**Wireless sensor networks:** Introduction to wireless sensor networks, Applications of Sensor Networks, Comparison with Ad-hoc Wireless Networks, Issues and challenges in Designing a Sensor Network, Sensor Network Architecture, Comparison of MAC in ad-hoc and WSN, Energy management in WSN.	**9L**

Text Books:

1. C. Siva Ram Murthy and B.Smanoj, " Ad Hoc Wireless Networks – Architectures and Protocols", Pearson

Reference Books:

1. Feng Zhao and Leonidas Guibas, "Wireless Sensor Networks", Morgan Kaufman Publishers
2. C.K.Toh, "Ad Hoc Mobile Wireless Networks", Pearson Education
3. Thomas Krag and Sebastin Buettrich, "Wireless Mesh Networking", O'Reilly
4. Internet as Source of Reference

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course: Knowledge of Network System

Course Learning Outcomes:

CO-1	Evaluate and analyze the issues in ad-hoc networks, energy consumption and management	**L2 & L3**
CO-2	Explain the challenges in designing MAC, routing and transport protocols for wireless ad-hoc networks.	**L3 &L4**
CO-3	Examine the issues in designing protocols and Classifications of Routing Protocols	**L1& L3**
CO-4	lustrate TCP issues in ad-hoc networks.	**L2 & L3**
CO-5	Discuss the architecture and protocols of wireless sensor networks. Contrast the issues in Ad-hoc and wireless sensor networks.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1: Remember, L2: Understand, L3: Apply, L4 : Analyze)

CO-PO Mapping
Ad Hoc Wireless Networks (MSCS-123)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12

CO-1	3	-	3	-	-	-	-	1	-	-	-	-
CO-2	3	2	3	-	-	-	-	1	-	-	-	-
CO-3	3	2	3	-	-	-	-	1	-	-	-	-
CO-4	3	2	3	-	-	-	-	1	-	-	-	-
CO-5	3	2	3	2	2	-	-	1	-	-	-	-

Foramt-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech (CSE)**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Research and Publication Ethics**
Course Code: MSRE-121	**Title: Research and Publication Ethics**

Course Objectives:

1. To understand the importance of philosophy of science and ethics.
2. To identify research misconduct and predatory publications.
3. To understand the open access publications, research metrics.
4. To understand the usage of plagiarism tools.
5. To develop effective scientific communication skills for writing research papers, proposals, and presentations.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Philosophy and Ethics:** Definition of philosophy; nature and scopes; basic concepts; different branches. Define Ethics; moral philosophy; judgements and reactions.	9L
II	**Scientific Conduct:** Ethics in science and research; Intellectual honesty and research integrity. Scientific misconducts: Falsification; Fabrication and Plagiarism; Redundant. Publications: duplicate and overlapping publications; Selective reporting and misrepresentation of data.	9L
III	**Publication Ethics:** definition; importance; standards setting initiatives and guidelines: COPE, WAME, etc.; Conflicts of interest; Publication misconduct: definition; concept; unethical behavior; types; Violation of publication ethics; authorship and contributor ship; Identification, complaints and appeals for misconduct; Predatory publisher and journals.	9L
IV	**Open Access Publishing:** Open access publications and initiatives; SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies; Software tool to identify predatory publications developed by SPPU - Journal finger / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer, Journal Suggester, etc.	9L

V	**Publication Misconduct:** Use and importance of plagiarism software like Turnitin, Urkund and other open source software tools.	**9L**

Reference/ Text Books:

1. Nicholas H. Steneck. Introduction to the Responsible Conduct of Research. Office of Research Integrity. 2007. Available at: https://ori.hhs.gov/sites/default/files/rcrintro.pdf
2. The Student's Guide to Research Ethics By Paul Oliver Open University Press, 2003
3. Responsible Conduct of Research By Adil E. Shamoo; David B. Resnik Oxford University Press, 2003
4. Ethics in Science Education, Research and Governance Edited by Kambadur Muralidhar, Amit Ghosh Ashok Kumar Singhvi. Indian National Science Academy, 2019. ISBN : 978-81-939482-1-7.
5. Anderson B.H., Dursaton, and Poole M.: Thesis and assignment writing, Wiley Eastern 1997.
6. Bijorn Gustavii: How to write and illustrate scientific papers? Cambridge University Press.
7. Bordens K.S. and Abbott, B.b.: Research Design and Methods, McGraw Hill, 2008.
8. Graziano, A., M., and Raulin, M.,L.: Research Methods – A Process of Inquiry, Sixth Edition, Pearson, 2007.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	0
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	0
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To understand the fundamental concepts of philosophy and ethics in scientific research.	**L2 & L3**
CO-2	To identify and address various forms of scientific misconduct, including falsification, fabrication, and plagiarism.	**L3 &L4**
CO-3	To apply publication ethics standards and manage conflicts of interest in research and publication.	**L1& L3**
CO-4	To navigate open access publishing and utilize tools to identify predatory publications.	**L2 & L3**
CO-5	To effectively use plagiarism detection software to ensure research integrity and originality.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Research and Publication Ethics (MSRE-121)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2

CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M. Tech (CSE)**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Mobile Computing**
Course Code: MECS-121	**Mobile Computing**

Course Objectives:

1. Understand the concept / fundamentals of mobile computing and their types.
2. Understand the practical applications of various protocols in the area of mobile computing.
3. Understand data management issues and clustering.
4. Understand the importance of transaction processing systems.
5. Understand the importance of routing protocols.

Nature of Paper: DSE (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to mobile computing, issues in mobile computing, overview of wireless telephony: cellular concept, GSM: air-interface, channel structure, location management: HLR-VLR, hierarchical, handoffs, channel allocation in cellular systems, CDMA, GPRS.	9L
II	Wireless Networking, Wireless multiple access protocols, TCP over wireless, Wireless applications, data broadcasting, Mobile IP, Wireless LAN Overview: MAC issues, IEEE 802.11, Bluetooth, WAP: Architecture, protocol stack, application environment, applications.	9L
III	Data management issues, adaptive clustering for mobile wireless networks, data replication for mobile computers, File system, Disconnected operations.	9L
IV	Mobile Agents computing, transaction processing in mobile computing environment, security and fault tolerance.	9L
V	Ad-hoc networks, localization, MAC issues, QoS in Ad Hoc Networks, applications, Routing protocols, global state routing (GSR), Destination sequenced distance vector routing (DSDV), Dynamic source routing (DSR), Ad Hoc on demand distance vector routing (AODV), Temporary ordered routing algorithm (TORA).	9L

Text Books:
1. Thampi - Mobile Communications and Computing ,Wiley
2. J. Schiller, Mobile Communications, Addison Wesley.
3. Charles Perkins, Mobile IP, Addison Wesley.
4. Stojmenovic, Handbook of Wireless Networks and Mobile Computing, Wiley India.

Reference Books:
1. Charles Perkins, Ad hoc Networks, Addison Wesley.
2. Upadhyaya, "Mobile Computing", Springer.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course: Bachelor degree in computer science & Engineering.

Course Learning Outcomes:

CO-1	To Identify/introduce mobile computing.	**L2 & L3**
CO-2	To study about wireless networking & MAC.	**L3 &L4**
CO-3	To conceptualize the working of data management & data replication.	**L1& L3**
CO-4	To apply performance evaluation methods for security and Fault tolerance..	**L2 & L3**
CO-5	To become familiar with feature knowledge of Ad-hoc network & routing protocols.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Mobile Computing (MECS-121)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	1	3	3	1	1	3	1	-	-	-	-
CO-2	2	2	3	3	2	2	-	2	-	-	-	-
CO-3	3	3	2	2	-	2	3	3	-	-	-	-
CO-4	1	3	2	2	3	2	-	3	-	-	-	-
CO-5	1	2	3	3	1	3	3	2	-	-	-	-

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG (R) **Class: M.Tech (CSE)**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Software Project Management**
Course Code: MECS-122	**Title: Software Project Management**

Course Objectives:
1. Basic concepts and frameworks of Software Project Management (SPM)
2. Understand overall software development life cycle and adopt suitable processes.
3. Analyze, prioritize, and manage both functional and quality requirements.
4. Estimate efforts required, plan, and track the plans.
5. Understand and apply configuration and quality management techniques.

Nature of Paper: DSE (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION AND SOFTWARE PROJECT PLANNING:** Fundamentals of Software Project Management (SPM), Need Identification, Vision and Scope document, SPM Objectives, SPM Framework, Project Management Cycle, Management Spectrum, Project Plan, Structure of a Software Project Management Plan, Types of project plan, Software Project Planning, Planning Objectives, Software project estimation, Estimation models, Estimation methods, Decision process	**9L**
II	**PROJECT ORGANIZATION AND SCHEDULING:** Project Elements, Project Life Cycle and Product Life Cycle, Ways to Organize Personnel, Project schedule, Scheduling Objectives, Building the project schedule, Scheduling terminology and techniques, Work Breakdown Structure (WBS), Types of WBS, Functions, Activities and Tasks, Network Diagrams: PERT, CPM, Bar Charts: Milestone Charts, Gantt Charts	**9L**
III	**PROJECT MONITORING AND CONTROL:** Dimensions of Project Monitoring & Control, Earned Value Analysis, Earned Value Indicators: Cost Variance (CV), Schedule Variance (SV), Budgeted Cost for Work Scheduled (BCWS), Cost Performance Index (CPI), Schedule Performance Index (SPI), Error Tracking, Interpretation of Earned Value Indicators, Software Reviews, Types of Review: Walkthroughs,	**9L**

	Inspections, Code Reviews, Desk checks, Pair Programming.	
IV	**SOFTWARE QUALITY ASSURANCE AND TESTING:** Testing Objectives, Testing Principles, Test Strategies, Types of Testing, Levels of Testing, Test Plans, Test Cases, Program Verification & validation, Program Correctness, Testing Automation & Testing Tools, Concept of Software Quality, Software Quality Attributes, Software Quality Metrics and Indicators, SQA Activities, Formal SQA Approaches: Proof of correctness, Statistical quality assurance, Cleanroom process, The SEI Capability Maturity Model CMM).	**9L**
V	**PROJECT MANAGEMENT AND PROJECT MANAGEMENT TOOLS:** Software Configuration Management: Software Configuration Items and tasks, Baselines, Plan for Change, Change Control, Change Requests Management, Version Control, Software Project Management Tools: CASE Tools, Planning and Scheduling Tools, MS-Project, Risk Management: Risks and risk types, Risk Breakdown Structure (RBS), Risk Management Process: Risk identification, Risk analysis, Risk planning, Risk monitoring, Cost Benefit Analysis.	**9L**

Text Books:

1. M. Cotterell, Software Project Management, Tata McGraw-Hill Publication.
2. Royce, Software Project Management, Pearson Education.
3. Kieron Conway, Software Project Management, Dreamtech Press.

Reference Books:

1. S. A. Kelkar, Software Project Management, PHI Publication
2. Harold R. Kerzner, Project Mangment "A Systems Approach to Planning, Scheduling, and Controlling" Wiley
3. Mohapatra, Software Project Management, Cengage Learning.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course: Basic Knowledge of Software Engineering

Course Learning Outcomes:

CO-1	Basic concepts and frameworks of Software Project Management (SPM).	**L1 & L2**
CO-2	Understand overall software development life cycle and adopt suitable processes.	**L1 &L2**
CO-3	Analyze, prioritize, and manage both functional and quality requirements.	**L2& L4**

CO-4	Estimate efforts required, plan, and track the plans.	**L3 & L4**
CO-5	Understand and apply configuration and quality management techniques.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Software Project Management (MECS-122)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	3	2	2	2	3	1	1	3	1	3
CO-2	1	2	0	1	1	0	0	0	1	0	1	1
CO-3	1	2	0	1	1	1	0	0	1	0	1	2
CO-4	2	3	3	2	1	1	2	1	2	2	1	2
CO-5	2	2	1	1	2	1	2	2	2	2	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG (R) **Class: M.Tech (CSE)**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Grid Computing**
Course Code: MECS-123	**Title: Grid Computing**

Course Objectives:
1. Explain Grid computing infrastructure and architecture
2. Experiment with Grid Computing protocols and models
3. Demonstrate Grid scheduling and monitoring framework
4. Apply the concept of Hadoop and other grid middleware
5. Identify security issues in grid computing & compare the cloud environments

Nature of Paper: DSE (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION:** Evolution of Distributed computing, Scalable computing over the Internet, Technologies for network based systems, clusters of cooperative computers. Grid computing Infrastructures, cloud computing, service oriented architecture, Introduction to Grid Architecture and standards, Elements of Grid, Overview of Grid Architecture	9L
II	**GRID COMPUTING PROTOCOLS AND MODELS:** High Performance computing – cluster Computing, Peer-to-peer Computing, Internet Computing, Grid Computing, Grid Computing Models, Grid protocols, Types of Grids: Desktop Grids, Cluster Grids, HPC Grids, Data Grids	9L
III	**GRID MONITORING ARCHITECTURE AND SCHEDULING:** Grid Monitoring Architecture (GMA) - An Overview of Grid Monitoring Systems, Grid Scheduling and Resource Management, Scheduling Paradigms, Working principles of Grid Scheduling with QoS, QoS based resource provisioning and scheduling in grids	9L
IV	**MIDDLEWARE:** Introduction to Hadoop Framework, Design of Hadoop file system, HDFS concepts, Introduction to Open Grid Services Architecture (OGSA), Motivation, Functionality Requirements, Practical & Detailed view of OGSA/OGSI, Data intensive grid service models, OGSA services	9L

V	**SECURITY:** Trust models for Grid security environment, Authentication and Authorization methods, Grid security infrastructure, Security issues in grid computing, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud, Key privacy issues in the cloud	**9L**

Text Books:

1. Kai Hwang, Geoffery C. Fox and Jack J. Dongarra, "Distributed and Cloud Computing: Clusters, Grids, Clouds and the Future of Internet", First Edition, Morgan Kaufman Publisher, an Imprint of Elsevier, 2012.
2. Maozhen Li, Mark Baker, The Grid Core Technologies, John Wiley & Sons, 2005.

Reference Books:

1. Jason Venner, "Pro Hadoop- Build Scalable, Distributed Applications in the Cloud", A Press, 2009
2. Tom White, "HadoopThe Definitive Guide", First Edition. O"Reilly, 2009.
3. Bart Jacob (Editor), "Introduction to Grid Computing", IBM Red Books, Vervante, 2005

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course: Basic knowledge of Computer Networks

Course Learning Outcomes:

CO-1	Understand the concept of Grid computing infrastructure and architecture.	**L2 & L3**
CO-2	Experiment with Grid Computing protocols and models.	**L3 &L4**
CO-3	Demonstrate Grid scheduling and monitoring framework.	**L1& L3**
CO-4	Apply the concept of Hadoop and other grid middleware.	**L2 & L3**
CO-5	Identify security issues in grid computing & compare the cloud environments.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Grid Computing (MECS-123)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	0	3	1	0	1	0	0	0	0	1	2
CO-2	3	2	3	0	0	0	0	1	0	0	0	2
CO-3	3	2	3	0	0	0	0	1	0	0	1	2
CO-4	3	2	3	0	0	0	0	1	0	0	1	2
CO-5	3	0	3	2	2	0	0	1	0	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech (CSE)**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Advance Cryptography**
Course Code: MECS-124	**Title: Advance Cryptography**

Course Objectives:
The main objective of the course is to Introduce to students Advance theories, techniques of Cryptography. Applications that are frequently required for understanding and transmission of data across networks.

Nature of Paper: DSE (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Basic Concept of Network Security Mapping Cryptographic Protocols:** Review of modern cryptographic techniques. Authentication, digital signatures, Key exchange, Time stamping services, Undeniable digital Signatures, Proxy signatures, Group signatures, Fail stop digital signatures. Zero knowledge Proofs, Zero Knowledge proofs of identity, Blind signatures, Identity based public key cryptography.	9L
II	**Cryptographic Techniques:** Mathematics behind cryptographic key, symmetric key length and public key length, Birthday attack, key management. Block Cipher Techniques - Lucifer, Madryga, New DES, FEAL-4, REDOC, IDEA, MMB, CAST, BLOWFISH, CRAB, RC5.	9L
III	**Hash Functions:** One way hash functions - MD2, MD4, MD-5, SHA, RIPMED, HAVAL, Key Exchange Algorithms - Station to Station, Shamir's Algorithm, COMSET.	9L
IV	**Digital Signatures:** DSA, DSA variants, Ghost signature algorithms, Discrete Logarithmic Signature Schemes, Ong-Schnorr-Shamir Signature Scheme, Electronic Signatures in Global and National Commerce Act, Identification schemes-Feige–Fiat–Shamir identification scheme, The Guillou-Quisquater protocol, Schnorr signature.	9L
V	**Real Life Problems:** IBM secret key exchange protocol, Kerberos, PGP, Smart cards, PKCS, Message security protocol, Privacy Enhanced mail, SESAME	9L

Text Books:
1. Steven Galbraith, "Public Key Cryptography", Cengage Learning.

Reference Books:
1. Raymond R. Panko, "Corporate Computer and Network Security", Pearson Education.
2. Willam Stallings, "Cryptography and Network Security", Pearson Education.
3. Internet as a resource for references

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Course Learning Outcomes:

CO-1	Evaluate different cryptographic protocols	**L2 & L3**
CO-2	Apply advanced cryptographic Protocols with mathematical analysis.	**L3 &L4**
CO-3	Identify the security services in different real life scenarios.	**L1& L3**
CO-4	Demonstrate vulnerabilities, mechanisms to identify vulnerabilities/threats /attacks.	**L2 & L3**
CO-5	Compare various advanced cryptographic protocols used for Network Security.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Advance Cryptography- (MECS-124)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	3	2	3	2	1	0	0	0	0	3	2
CO-2	3	3	2	2	2	1	0	0	0	0	1	2
CO-3	2	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	3	2	3	2	1	0	0	0	0	1	1
CO-5	2	3	2	3	3	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech (CSE)**	**Year: I** **Semester: II**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Advanced Computer Network Lab**
Course Code: MSCS-121P	**Title: Advanced Computer Network Lab**

Course Objectives:

1. Design and implement various network protocols with the concept of layered approach of OSI and TCP/IP model.
2. Advanced concepts of data communication and computer networks.
3. Concepts of Transport Layer protocol suite and network tools .
4. Traffic Management & Security measures.

Nature of Paper: Core (Lab)

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Configuration and logging to a CISCO Router and introduction to the basic user Interfaces. Introduction to the basic router configuration and basic commands.
Practical-2.	Configuration of IP addressing for a given scenario for a given set of topologies.
Practical-3.	Configure a DHCP Server to serve contiguous IP addresses to a pool of four IP devices with a default gateway and a default DNS address. Integrate the DHCP server with a BOOTP demon to automatically serve Windows and Linux OS Binaries based on client MAC address.
Practical-4.	Configure, implement and debug BGP routing
Practical-5.	Configure, implement and debug OSPF routing protocols
Practical-6.	Simulation of TCP variants for wireless communication
Practical-7.	Simulation of TCP, UDP and SCTP with constant traffic for VOIP services
Practical-8.	Simulation of TCP and SCTP Flow control.
Practical-9.	Simulation of TCP and SCTP congestion control
Practical-10.	Implement AES and DES and compare
Practical-11.	Implement RSA
Practical-12.	Implementing Admission Control protocols.

Text Books:
1. Srinivasan Keshav "An Engineering Approach to Computer Networking ", Pearson.
2. A.Tanenenbaum, "Computer Network", PHI.

Reference Books:
1. W. Richard Stevens "TCP/IP Illustrated"-Pearson.
2. W. Stallings, "Wireless Communication and Networks" Pearson.
3. Internet as source of Reference.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		10
3) External Practical Assessment	External Assessment	15
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Examine the various difference and challenges in wired and wireless Data networks	**L2 & L3**
CO-2	Define various routing protocols and mobile IP.	**L1 &L3**
CO-3	Examine the behavior of various Transport Layer Protocols.	**L2 & L4**
CO-4	Illustrate various Flow Control, Congestion Control and QoS Protocols.	**L3 & L4**
CO-5	Outline several Traffic scheduling algorithms and Identify various Encryption Techniques.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Advanced Computer Network Lab (MSCS-121P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	3	1	0	0	1	2	0	0	2	2
CO-2	3	2	3	0	0	0	1	2	0	0	1	2
CO-3	2	2	3	1	0	0	0	0	1	0	1	2
CO-4	3	1	2	2	0	0	2	0	2	3	3	0
CO-5	2	3	3	1	0	0	1	1	2	1	2	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG (R) **Class: M.Tech (CSE)**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical 0**	**Subject: Internet of Things**
Course Code: MECS-231	**Title: Internet of Things**

Course Objectives:
1. To analyse, design and develop IOT solutions.
2. To explore the entrepreneurial aspect of the Internet of Things.
3. Identify the main components of Internet of Things.
4. Assess different Internet of Things technologies and their applications.
5. Model IOT to business.

Nature of Paper: DSE (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION:** Motivation & Need of IoT, Overview & Introduction, IoT Communication Protocols, Making Things Smart: Getting things onto the Internet	9L
II	**INTERNET OF THINGS (IOT) AND WEB OF THINGS (WOT):** IoC to IoT, IoT to WoT, Internet & Web Layering	9L
III	**BUSINESS ASPECTS OF THE IOT:** Business cases & Concepts, Business Issues & Models, Persuasive Technologies & Behavioral change	9L
IV	**MODELING:** Representational State Transfer (REST), Activity Streams, Making Things Smart: Getting things onto the Internet	9L
V	**APPLICATIVE DIMENSION:** Big Data & Semantic Technologies, Implications of Society, IoT in the Wild	9L

Text Books:
1. SudipMisra, Anandarup Mukherjee, Arijit Roy, "Introduction to IoT", First Edition, Cambridge University Press, 2022.
2. http://dret.net/lectures/iot-spring15/

Reference Books:
1. http://www.ischool.berkeley.edu/newsandevents/events/20140226yingding

2. Internet as a Resource for Reference	
If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**	
Evaluation/Assessment Methodology	
Category	**Max. Marks**
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**
Prerequisites for the course: Knowledge of Computer System, basics of AI/ML and sensors.	

Course Learning Outcomes:

CO-1	Analyze types of technologies that are available and in use today and can be utilized to implement IoT solutions.	**L2 & L3**
CO-2	Apply IoT technologies to tackle business scenarios.	**L3 &L4**
CO-3	Identify the main components of Internet of Things.	**L1& L3**
CO-4	Program the sensors and controller as part of IOT.	**L2 & L3**
CO-5	Assess different Internet of Things technologies and their applications and Model IOT to business.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1: Remember, L2: Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Internet of Things (MECS-231)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	1	2	1	1	3	2	2	2	1	2
CO-2	3	3	1	2	1	1	2	2	2	2	1	2
CO-3	3	3	1	2	1	1	3	1	1	2	1	2
CO-4	3	3	1	2	1	1	2	2	2	2	1	2
CO-5	3	2	1	2	1	1	3	2	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech (CSE)**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Cloud Computing**
Course Code: MECS-232	**Title: Cloud Computing**

Course Objectives:

1. To understand the concept and latest paradigm in the field of cloud computing.
2. To get to know about the various security issues and challenges in cloud computing.
3. To learn about Cloud Computing.
4. The primary objectives of cloud computing include increasing efficiency, scalability, and flexibility of IT resources, while reducing costs and complexity.

Nature of Paper: DSE (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction: Introduction and Evolution of Computing Paradigms:** History and Evolution, Introduction to Cloud Computing, Definition of Cloud, Existing usage of cloud computing, New paradigm in the cloud, Applications. **Cloud Computing Architectural Framework Cloud:** Benefits, Underlying Principles of Parallel and Distributed Computing, Cloud Characteristics, Elasticity in Cloud – On-demand Provisioning.	9L
II	**Enabling Technologies:** Service Oriented Architecture – REST and Systems of Systems, Web Services, Publish- Subscribe Model. **Vendor Lock-in and Efforts at Standardization:** Need of migration; Preventing vendor lock-in. **Virtualization:** Basics of virtualization, Server virtualization, VM migration techniques, Role of virtualization in cloud computing, pros and cons of virtualization, Virtualization Structures – Tools and Mechanisms, Virtualization of CPU, Memory, I/O Devices, Virtualization Support and Disaster Recovery.	9L
III	**Cloud Architecture, Services and Storage:** Layered Cloud Architecture Design, NIST Cloud Computing Reference Architecture. **Public, Private and Hybrid Clouds:** Their benefits and challenges,	9L

	Private vs Public cloud, laaS, PaaS, SaaS, Cloud Economics and Capacity Management: Restricted choices; Capacity planning; Queuing and response time, Architectural Design Challenges, Cloud Storage, Storage as a Service, Advantages of Cloud Storage – Cloud Storage Providers – S3, Data loss or leakage, Account or service hijacking	
IV	**Resource Management and Security in Cloud:** Inter Cloud Resource Management – Resource Provisioning and Resource Provisioning Methods. **Overview of cloud Security:** Explain the security concerns in Traditional IT, Challenges of cloud computing in terms of application security, server security, and network security, Cloud Reliability, Fault Tolerance and Response Time, Software as a Service Security, Security as a Service by cloud providers, Security Governance, Virtual Machine Security, IAM Security Standards.	**9L**
V	**Cloud Technologies and Advancements: Classification of Cloud implementations:** Amazon's cloud services (AWS), The Elastic Compute Cloud (EC2). The Simple Storage Service (S3), The Simple Queuing Services (SQS), Google App Engine - PaaS, Windows Azure, Hadoop, Map Reduce, Virtual Box, Open Stack, Federation in the Cloud, Four Levels of Federation, Federated Services and Applications, Cloud software for private banking, Selection criteria for cloud deployment, Issues risk in cloud computing, Future technology trends in cloud computing.	**9L**

Text Books:

1. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.

Reference Books:

1. Ritting house, John W., and James F. Ransome, —Cloud Computing: Implementation, Management and Security, CRC Press, 2017.
2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, —Mastering Cloud Computing, Tata Mcgraw Hill, 2013.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course: Fundamental Knowledge Of Programming Language.

Course Learning Outcomes:		
CO-1	To know cloud computing and its framework.	**L2 & L3**
CO-2	To make understand virtualization & its types.	**L3 & L4**
CO-3	To know about cloud computing deployment models and its types.	**L1 & L3**
CO-4	To know about the cloud computing service provider.	**L2 & L3**
CO-5	Develop and analyze cloud computing solutions using Hadoop.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Cloud Computing (MECS-006)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	2	3	-	2	1	2	1	1	-	2	2
CO-2	2	2	3	2	2	-	1	1	1	3	2	1
CO-3	3	2	-	-	-	3	3	1	-	1	-	1
CO-4	3	3	-	3	-	2	-	-	1	-	-	1
CO-5	2	3	1	3	-	1	1	-	1	-	-	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG (R) **Class: M.Tech (CSE)**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Natural Language Computing**
Course Code: MECS-233	**Title: Natural Language Computing**

Course Objectives:

1. Identify Linguistic phenomena and an ability to model them with formal grammars.
2. Illustrate proper experimental methodology for training and evaluating empirical NLP systems.
3. Use probabilities, construct statistical models over strings and trees, and estimate parameters using supervised and unsupervised training methods
4. Compare algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics.
5. Integrate knowledge representation, inference, and relations to the artificial intelligence and support Machine Translation techniques in intelligent systems.

Nature of Paper: DSE (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION:** Definition, History, Applications, Goals, Regular expressions and Automata, Morphology and Finite State Transducers	9L
II	**N-GRAMS:** Introduction, Simple (Unsmoothed) N-Grams, Smoothing: Add-one smoothing, Witten-Bell Discounting, Good-Turing Discounting, Back off, Deleted Interpolation. Entropy	9L
III	**HMM:** Overview, Viterbi Algorithm, Syntax: Word Classes and Part-of Speech Tagging, Context Free Grammars for English, Parsing with Context-Free Grammars	9L
IV	**CLASSIFICATION:** Word Sense Disambiguation: Selection Restriction Based Disambiguation, Robust WSD: Machine Learning, Supervised Learning Approaches, Bootstrapping Approaches, Unsupervised Methods, Dictionary Based Approaches.	9L
V	**MACHINE TRANSLATION:** Introduction, Language Similarities and Differences, Approaches, in machine translation system design.Steps involved in machine translation system design.	9L

Text Books:

1. Jurafsky, D. & J. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing Computational Linguistics, and Speech Recognition" Prentice Hall.
2. Grosz, B.J., Sparck Jones, K. & Webber, B.L. (eds) "Readings in natural language processing", Los Altos, CA. Morgan Kaufmann.

Reference Books:

1. Allen, J., "Natural Language Understanding", Redwood City, Benjamin/Cummings
2. Bharti, Akshar, Chaitanya Vineet, Sangal Rajeev, "Natural Language Processing", Prentice Hall

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course: Basic Knowledge of Theory of Computation and Machine Learning

Course Learning Outcomes:

CO-1	Identify Linguistic phenomena and an ability to model them with formal grammars.	**L1 & L3**
CO-2	Illustrate proper experimental methodology for training and evaluating empirical NLP systems.	**L3 &L4**
CO-3	Use probabilities, construct statistical models over strings and trees, and estimate parameters using supervised and unsupervised training methods.	**L1& L3**
CO-4	Compare algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics.	**L2 & L4**
CO-5	Integrate knowledge representation, inference, and relations to the artificial intelligence and support Machine Translation techniques in intelligent systems.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Natural Language Computing (MECS-233)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	1	1	2	3	1	3	1	1	2	1	2
CO-2	3	3	3	3	2	2	2	2	2	3	2	3
CO-3	3	2	3	2	1	1	3	1	1	2	1	2
CO-4	3	3	1	2	1	1	2	2	2	2	1	2
CO-5	2	2	2	3	1	1	3	2	2	2	0	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech (CSE)**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Malware Analysis Detection & Prevention**
Course Code: MECS-234	**Title: Malware Analysis Detection & Prevention**

Course Objectives:
The objective of this course is to provide an insight to fundamentals of malware analysis, detection and prevention such as different types of malware, static and dynamic analysis, functionality and detection technique of malware.

Nature of Paper: DSE (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L : 4	**T :** 1	**P :** 0	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** A Introduction to malware, OS security concepts, malware threats, evolution of malware, Malware types, viruses, worms, rootkits, Trojans, bots, spyware, adware, logic bombs, Malware analysis, static malware analysis, dynamic malware analysis.	**9L**
II	**Antivirus Scanning:** A Useful First Step, Hashing: A Fingerprint for Malware, Finding Strings, Packed and Obfuscated Malware, Portable Executable File Format, Linked Libraries and Functions. **Static Analysis in Practice, Potential Key logger exe:** An Unpacked Executable, Packed Program.exe: A Dead End, The PE File Headers and Sections **Malware analysis in virtual machines:** The Structure of a Virtual Machine, Creating Your Malware Analysis Machine, Configuring VMware, Using Your Malware Analysis Machine	**9L**
III	**Dynamic Analysis** **A Sandboxes:** The Quick-and-Dirty Approach, Using a Malware Sandbox, Sandbox Drawbacks, Running Malware, Monitoring with Process Monitor, The Procmon Display, Filtering in Procmon. **Viewing Processes with Process Explorer:** The Process Explorer Display, Using the Verify Option, Comparing Strings, Using Dependency Walker, Analyzing Malicious Documents. Comparing Registry Snapshots with Regshot, Faking a Network: Using Apate DNS,	**9L**

	Monitoring with Netcat, Packet Sniffing with Wireshark, Using INetSim, Basic Dynamic Tools in Practice	
IV	**Malware Functionality:** Downloaders and Launchers, Backdoors, Credential Stealers, Persistence Mechanisms, Privilege Escalation, Covering Its Tracks—User-Mode Rootkits, Covert malware launching-Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection	**9L**
V	**Malware Detection Techniques:** Signature-based techniques: malware signatures, packed malware signature, metamorphic and polymorphic malware signature, Non-signature based techniques: similarity-based techniques, machine-learning methods, invariant inference, Case Studies – Plankton, Droid Kung Fu, Anserver Bot, Smartphone (Apps) Security	**9L**

Text Books:

1. Michael Sikorski and Andrew Honig, "Practical Malware Analysis : The Hands-On Guide to Dissecting Malicious Software", No Starch Press,2012.

Reference Books:

1. Jamie Butler and Greg Hoglund, "Rootkits: Subverting the Windows Kernel", Addison-Wesley, 2005.
2. Dang, Gazet, Bachaalany, "Practical Reverse Engineering", Wiley, 2014.
3. Reverend Bill Blunden, "The Rootkit Arsenal: Escape and Evasion in the Dark Corners of the System" Second Edition, Jones & Bartlett, 2012.
4. Monnappa K A, "Learning Malware Analysis: Explore the concepts, tools, and techniques to analyze and investigate Windows malware".

If the course is available as **Generic Elective**, then the students of following departments may opt it:
NO

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Course Learning Outcomes:

CO-1	Illustrate the nature of malware, its capabilities, types and its analysis	**L2 & L3**
CO-2	Apply the tools and methodologies used to perform static analysis.	**L3 &L4**
CO-3	Apply the tools and methodologies used to perform dynamic analysis.	**L1& L3**
CO-4	Explain executable formats, Windows internals and API, and detection and prevention techniques	**L2 & L3**
CO-5	Utilize the techniques of signature-based and non signature based of malware detection.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Malware Analysis Detection & Prevention (MECS-234)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	2	3	2	2	2	1	0	0	0	0	2	2
CO-2	3	2	2	3	2	1	0	0	0	0	1	2
CO-3	2	3	2	3	1	0	0	0	0	0	1	2
CO-4	3	2	2	3	2	1	0	0	0	0	1	1
CO-5	2	3	2	3	2	1	0	0	0	0	1	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG (R) **Class: M.Tech (CSE)**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Data Compression**
Course Code: MECS-235	**Title: Data Compression**

Course Objectives:

1. To provide the knowledge of various data compression techniques and its use in engineering problems.
2. To introduce students to the theory and practice of data compression, as well as to make students comfortable processing real-world audio and video signals on a computer.
3. To introduce students to basic applications, concepts, and techniques of Data Compression.
4. To develop skills for using recent data compression software to solve practical problems in a variety of disciplines.
5. To gain experience doing independent study and research.

Nature of Paper: **DSE (Theory)**

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Compression Techniques: Loss less compression, Lossy Compression, Measures of performance, Modeling and coding, Mathematical Preliminaries for Lossless compression: A brief introduction to information theory, Models: Physical models, Probability models, Markov models, composite source model, Coding: uniquely decodable codes, Prefix codes.	**9L**
II	The Huffman coding algorithm: Minimum variance Huffman codes, Adaptive Huffman coding: Update procedure, Encoding procedure, Decoding procedure. Golomb codes, Rice codes, Tunstall codes, Applications of Hoffman coding: Loss less image compression, Text compression, Audio Compression.	**9L**
III	Coding a sequence, Generating a binary code, Comparison of Binary and Huffman coding, Applications: Bilevel image compression-The JBIG standard, JBIG2, Image compression. Dictionary Techniques: Introduction, Static Dictionary: Diagram Coding, Adaptive Dictionary. The LZ77 Approach, The LZ78 Approach, Applications: File Compression-UNIX compress, Image Compression: The Graphics Interchange Format (GIF), Compression over Modems: V.42 bits,	**9L**

	Predictive Coding: Prediction with Partial match (ppm): The basic algorithm, The ESCAPE SYMBOL, length of context, The Exclusion Principle, The Burrows-Wheeler Transform: Move-to-front coding, CALIC, JPEG-LS, Multi-resolution Approaches, Facsimile Encoding, Dynamic Markoy Compression.	
IV	Distortion criteria, Models, Scalar Ouantization: The Quantization problem, Uniform Quantizer, Adaptive Quantization, Non uniform Quantization.	**9L**
V	Advantages of Vector Quantization over Scalar Quantization, The Linde-Buzo-Gray Algorithm, Tree structured Vector Quantizers. Structured Vector Quantizers.	**9L**

Text Books:
1. Khalid Sayood, Introduction to Data Compression, Morgan Kaufmann Publishers.
2. Elements of Data Compression, Drozdek, Cengage Learning.

Reference Books:
1. Introduction to Data Compression, Second Edition, Khalid Sayood, The Morgan aufmann Series.
2. Data Compression: The Complete Reference 4th Edition by David Salomon, Springer.
3. Text Compression1st Edition by Timothy C. Bell Prentice Hall.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course: Basic Knowledge Of Elementary Mathematics And Basic algorithms.

Course Learning Outcomes:

CO-1	Students will able to understand important of data compression.	**L2 & L3**
CO-2	Student will be able to develop a reasonably sophisticated data compression application.	**L3 &L4**
CO-3	Student is able to select methods and techniques appropriate for the task.	**L1& L3**
CO-4	Student is able to develop the methods and tools for the given task.	**L2 & L3**
CO-5	Learning of the distortion and quantization techniques.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Data CompressionMECS-235)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	1	3	1	1	1	1	1	1	1	2

CO-2	3	2	2	3	1	2	1	1	1	1	1	1
CO-3	3	2	2	3	1	2	1	1	1	1	1	1
CO-4	3	2	1	3	1	1	1	1	1	1	1	1
CO-5	3	2	1	3	1	1	1	1	1	1	1	1

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: II

Program: PG (R) **Class: M. Tech (CSE)**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Pattern Recognition**
Course Code: MECS-236	**Title: Pattern Recognition**

Course Objectives:
The objectives of this course is to teach the students:
1. To understand Pattern Recognition technique on different data sets.
2. To understand Pattern Recognition technique using mathematical formulas.
3. To understand the students various feature extraction techniques and classifiers, so that, they can implement these concepts in real life projects like information retrieval, data mining, document image analysis and recognition, computational linguistics, forensics, biometrics and bioinformatics.
4. To understand various classification techniques using classifiers.
5. To understand the concept of clustering.

Nature of Paper: DSE (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4	T: 1	P: 0	C: 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Introduction to pattern recognition systems and their design cycle, learning and adaptation. Data sets for pattern recognition, Pre Processing of Input data set, Output analysis, Application areas of pattern recognition with case studies in Medical, Defense and Optical Document Recognition.	9L
II	**Mathematical Background:** Bayes Rule, Expectation, Correlation, Covariance, Review of Linear Algebra, Linear Transformations, Decision Theory, ROC Curves, Likelihood Ratio Test, Linear Discriminants, FMI.	9L
III	**Feature Extraction:** Introduction, Shape representation Techniques – One dimensional function, polygonal approximation, spatial interrelation, Moments, Scale shape methods, Shape transform domains, Chi-square statistic, Singular value decomposition, Feature Selection for Time Series Data.	9L
IV	**Classification:** Applications of Classification techniques, Classification with and without learning, Support Vector Machine, k-Nearest Neighbour Classifier, Decision tree, Artificial Neural Network Classifiers- Multilayer Perceptron, Back propagation algorithms.	9L

V	**Clustering:** Clustering Large Datasets, Applications of Clustering, Clustering techniques–K Means, Sequential Algorithms, Agglomerative hierarchical Clustering, Functional Optimization-Based Clustering, Graph Clustering.	**9L**

Text Books:

1. Duda and Hart P.E, "Pattern classification and scene analysis", John Wiley and sons, NY.
2. Fu K.S., Eaglewood cliffs, "Syntactic Pattern recognition and applications", Prentice Hall, N.J.

Reference Books:

1. Earl Gose, Richard Johnsonbaugh, and Steve Jost, "Pattern Recognition and Image Analysis", PHI Pvt. Ltd., New Delhi.
2. Rochard O. Duda , Hart P.E, and David G Stork, "Pattern classification", John Wiley & Sons Inc.
3. Internet as source of Reference.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course: Basic knowledge of Statistical analysis

Course Learning Outcomes:

CO-1	To Identify/introduce the ideas of existing Patterns.	**L2 & L3**
CO-2	To implement existing patterns ideas based on data analysis.	**L3 &L4**
CO-3	To conceptualize the working of patterns explorations using computational algorithms.	**L1& L3**
CO-4	To apply performance evaluation methods for pattern recognition.	**L2 & L3**
CO-5	To become familiar with feature knowledge that can be extracted from available examples and generalize to form appropriate feature models.	**L2& L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Pattern Recognition (MECS-236)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	1	3	3	1	1	3	1	-	-	-	-
CO-2	2	2	3	3	2	2	3	2	-	-	-	-
CO-3	3	3	2	2	3	2	3	3	-	-	-	-
CO-4	1	3	2	2	3	2	3	3	-	-	-	-
CO-5	1	2	3	3	1	3	3	2	-	-	-	-

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG (R) **Class: M.Tech (CSE)**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Intrusion Detection and Prevention**
Course Code: MECS-237	**Title: Intrusion Detection and Prevention**

Course Objectives:

1. Provide an in depth introduction to intrusion detection and prevention..
2. Methodologies, techniques, and tools for monitoring events in computer system or network.
3. Objective of preventing and detecting unwanted process activity and recovering from malicious behavior.
4. Analyze and apply Snort rules, outputs, and plug-ins to detect unauthorized activity.
5. Different protocol analyzers tools & different tools related to traffic monitoring, snort, toolkits.

Nature of Paper: DSE (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION:** Intrusion Detection, basics of Intrusion detection and prevention, Intrusion Detection system and its types, Intrusion Prevention System, History, IDS and IPS analysis schemes, Attacks Detection approaches: Misuse detection, anomaly detection, specification-based detection, hybrid detection; Tiered Architecture of Intrusion Detection system and Intrusion Prevention System, DDos attacks, TCP reset attack, malformed DNS attack	9L
II	**TRAFFIC MONITORING:** tcp dump , binary packet capture, formats of tcp dump filters, bit masking, packet capturing using wires hark, wires hark display filters, Live network packet capturing, protocol analysis	9L
III	**PACKETS ANALYSIS:** Examination of fields in TCP checksums, normal and abnormal tcp stimulus and response, Detection methods for application protocols, pattern matching, protocol decode and anomaly detection, Sample attacks http, malformed dns, DDos, tcp reset attacks	9L
IV	**OPEN SOURCE IDS-SNORT:** Function of IDS, configuration of snort, flow process of snort, Model of operation sniffer, logger, NIDS, Writing snort rules, writing a rule for vulnerability	9L

V	**ANALYST TOOLKIT:** ngrep, tcp flow, netcat, using jpcap to create , read/write, alter and send packets, launch arp poisoning, dns poisoning attacks using jpcap	**9L**

Text Books:

1. Intrusion Detection & Prevention , Carl F. Endorf, Eugene Schultz and Jim Mellander, McGraw Hill Professional, 2004.

Reference Books:

1. Metasploit: The Penetration Tester's Guide by David Kennedy, Jim O'Gorman, Devon Kearns, Mati Aharoni
2. Internet as a Resource for Reference

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course: Basic Knowledge of Theory of Computation and Machine Learning

Course Learning Outcomes:

CO-1	Illustrate in-depth introduction to the Science and Art of Intrusion Detection and Prevention.	**L1 & L3**
CO-2	Demonstrate the skill to capture and analyze network packets.	**L3 &L4**
CO-3	Analyze packet and detection methods.	**L1& L3**
CO-4	Analyze and apply Snort rules, outputs, and plug-ins to detect unauthorized activity.	**L2 & L4**
CO-5	Apply different protocol analyzers tools and apply different tools related to traffic monitoring, snort, toolkits.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Intrusion Detection and Prevention (MECS-237)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	2	2	2	3	1	1	3	1	3
CO-2	1	2	0	1	1	0	0	0	1	0	1	1
CO-3	1	2	0	1	1	1	0	0	1	0	1	2
CO-4	2	3	3	2	1	1	2	1	2	2	1	2
CO-5	2	2	1	1	2	1	2	2	2	2	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech (CSE)**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Big Data Analytics**
Course Code: MECS-238	**Title: Big Data Analytics**

Course Objectives:

1. The objective of this course is to bring together several key big data technologies used for storage, analysis and manipulation of data.
2. To know the fundamental concepts of big data and analytics.
3. To explore tools and practices for working with big data.
4. To learn about stream computing.
5. To know about the research that requires the integration of large amounts of data.

Nature of Paper: **DSE (Theory)**

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Big Data and its Importance, Four V's of Big Data, Drivers for Big Data, Introduction to Big Data Analytics, Big Data Analytics applications. Algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce.	**9L**
II	Introduction HADOOP: Apache Hadoop .Hadoop Eco System, Moving Data in and out of Hadoop, Understanding inputs and outputs of MapReduce, Data Serialization.	**9L**
III	Hadoop Architecture, Hadoop Storage: HDFS, Common Hadoop Shell commands, Anatomy of File Write and Read., Name Node, Secondary Name Node, and Data Node, Hadoop Map Reduce paradigm, Map and Reduce tasks, Job, Task trackers-Cluster Setup–SSH & Hadoop Configuration – HDFS Administering –Monitoring & Maintenance.	**9L**
IV	HADOOP ECOSYSTEM AND YARN: Hadoop ecosystem components - Schedulers - Fair and Capacity, Hadoop 2.0 New Features- Name Node High Availability, HDFS Federation, MRv2, YARN, Running MRv1 in YARN.	**9L**
V	HIVE AND HIVEQL, HBAS: Hive Architecture and Installation, Comparison with Traditional Data base, Hive QL - Querying Data - Sorting And Aggregating, Map Reduce Scripts, Joins & Sub-queries, HBase concepts- Advanced Usage, Schema Design, Advance Indexing -	**9L**

	PIG, Zookeeper - how it helps in monitoring a cluster, HBase uses Zookeeper and how to Build Applications with Zookeeper.	

Text Books:

1. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, "Professional Hadoop Solutions", Wiley, ISBN: 9788126551071, 2015.

Reference Books:

1. Chris Eaton, Dirk deroos et al., "Understanding Big data", McGraw Hill, 2012. 3. Tom White, "HADOOP: The definitive Guide", O Reilly 2012.
2. Arvind Sathi, "Big Data Analytics: Disruptive Technologies for Changing the Game", 1st Edition, IBM Corporation, 2012.
3. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics", 1st Edition, Wiley and SAS Business Series, 2012.
4. Tom White, "Hadoop: The Definitive Guide", 3rd Edition, O'reilly, 2012. Sagar Naikand Piyu Tripathy, "Software Testing and Quality Assurance: Theory and Practice", Wiley.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course: Fundamental Knowledge of Programming Language.

Course Learning Outcomes:

CO-1	To bring together several key big data technologies used for storage, analysis and manipulation of data.	**L2 & L3**
CO-2	Identify and mitigate the challenges in Big data.	**L3 &L4**
CO-3	To recognize the key concepts of Hadoop framework, MapReduce, Pig, Hive, and No-SQL.	**L1 & L3**
CO-4	To prepare a sample project in Hadoop API.	**L2 & L3**
CO-5	Develop and analyze big data solutions using Hadoop and its ecosystem	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Big Data Analytics (MECS-238)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	-	3	-	-	-	-	3	3	-	-	-
CO-2	3	1	2	-	-	2	3	3	3	3	-	-

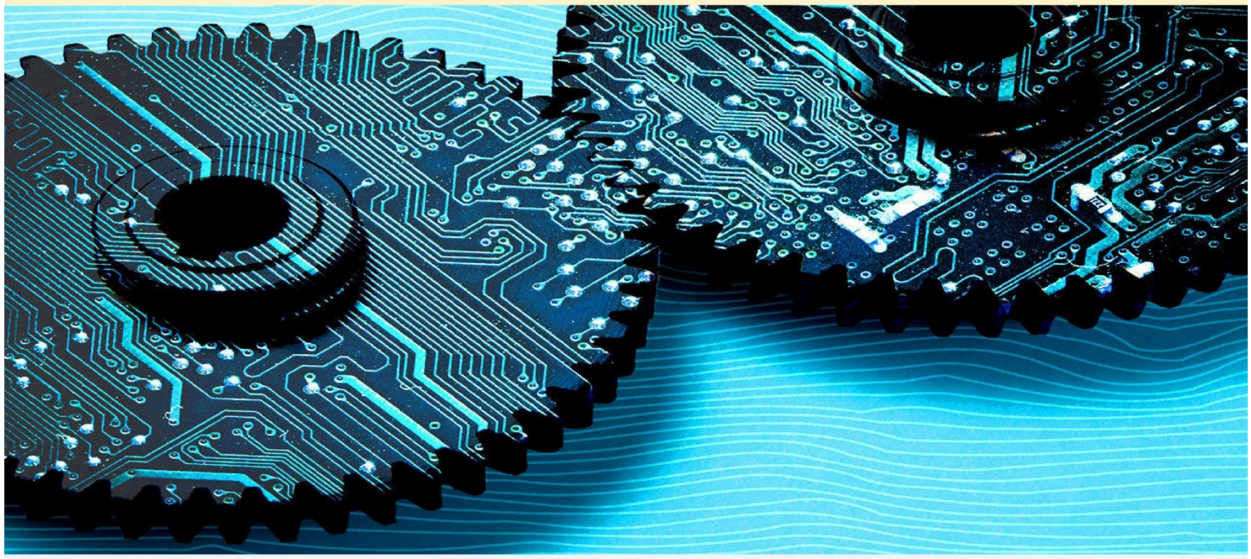
CO-3	3	1	2	1	1	2	2	3	3	3	-	-
CO-4	3	1	2	-	1	-	3	3	3	3	-	-
CO-5	3	-	2	1	-	2	2	3	3	3	-	-

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POST GRADUATE DEGREE COURSE IN CONSTRUCTION TECHNOLOGY AND MANAGEMENT (Academic Session 2025-26)

Evaluation Scheme

Master of Technology (Construction Technology and Management)

Evaluation Scheme – Master of Technology (Construction Technology and Management)
Year: I / Semester: I

S. No.	Subject Code	Subject Name	Type	Category	Periods / Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1	MSCT-111	Construction Equipment and Management Systems	Th	Core-1	4	1	-	4	20	10	30	70	100
2	MSCT-112	Automation In Construction Industry	Th	Core-2	4	1	-	4	20	10	30	70	100
3	MSCT-113	Construction Laws and Regulations	Th	Core-3	4	1	-	4	20	10	30	70	100
4	MSRM-111	Research Methodology	Th	Core-4	4	1	-	4	20	10	30	70	100
5	MECT-111 / MECT-112	Departmental Elective Course-I	Th	DSE-1	4	1	-	4	20	10	30	70	100
6	MSCT-111P	Construction Management Software Lab	P	LAB-1	0	0	2	2	10	10	20	30	50
7	NECC-111*	Industrial Visit/ Seminar/ Presentation On The Report Of Visits	P	AC	0	0	0	NC*	0	25*	25*	0	25*
8.	NECC-112*	University Social Responsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**20**	**5**	**2**	**22**	**110**	**60**	**170**	**380**	**550**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, SEC- Skill Enhancement Course, Th- Theory, ESE- End Semester Examination, AC- Audit course

*Note: (1) NECC-121 & NECC-122 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies during the semester. Student needs to qualify it but the marks will not be added in total marks
(2) A total of 4 Credits are mandatory to earn from NPTEL/Moocs/Coursera etc during 2 years of M.Tech Program.

Discipline Specific Electives -I	1. MECT-111 Organizational Behavior 2. MECT-112 Modern Construction Materials and Equipment

Evaluation Scheme – Master of Technology (Construction Technology and Management)
Year: I / Semester: II

S. No.	Subject Code	Subject Name	Type	Category	Periods / Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1	MSCT-121	Project Planning Scheduling and Control	Th	Core-5	4	1	-	4	20	10	30	70	100
2.	MSCT-122	Repair and Rehabilitation	Th	Core-6	4	1	-	4	20	10	30	70	100
3	MSCT-123	Construction Techniques of Deep Foundations	Th	Core-7	4	1	-	4	20	10	30	70	100
4	PGRPE-111	Research and Publication Ethics	Th	Core-8	4	1	-	4	20	10	30	70	100
5	MECT-121 MECT-122	Departmental Elective Course-II	Th	DSE-2	4	1	-	4	20	10	30	70	100
6	MSCT-121P	Construction Planning and Scheduling Lab	P	LAB-2	0	0	2	2	10	10	20	30	50
7	MSEC-121	Certification course (in advance technology on concern branch)	P	SEC-1	0	0	4	2	30	20	50	-	50
7	*NECC-121	Industrial Visit/ Seminar/ Presentation On The Report Of Visits	P	AC	0	0	0	NC*	0	25*	25*	0	25*
8	*NECC-122	University Social Responsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**20**	**5**	**6**	**24**	**140**	**80**	**220**	**380**	**600**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, DSE- Discipline Specific Elective, Th- Theory, ESE- End Semester Examination, AC- Audit course

*Note: NECC-121 & NECC-122 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies during the semester. Student needs to qualify it but the marks will not be added in total marks.

Discipline Specific Electives -II	1. MECT-121 Resource Management and Control In Construction 2. MECT-122 Disaster Reduction and Management

Evaluation Scheme – Master of Technology (Construction Technology and Management)
Year: II / Semester: III

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1	MECT-231-MECT-232	Departmental Elective Course-III	Th	DSE-3	4	1	-	4	20	10	30	70	100
2	MECT-233-MECT-234	Departmental Elective Course-IV	Th	DSE-4	4	1	-	4	20	10	30	70	100
3	MSCT-231P	Seminar	P	RP-1	0	0	5	4	-	-	40	60	100
4	MSCT-232P	Synopsis of Dissertation	P	RP-2	0	0	5	4	-	-	60	90	150
5	MSEC-231	Certification course (in advance technology on concern branch)	P	SEC-2	0	0	4	2	30	20	50	-	50
6	*NECC-231	Industrial Visit/ Seminar/Presentation on the report of visits	P	AC	0	0	0	NC*	0	25*	25*	0	25*
7	*NECC-232	University SocialResponsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**8**	**2**	**14**	**18**	**70**	**40**	**210**	**290**	**500**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, DSE- Discipline Specific Elective, Th- Theory, ESE- End Semester Examination, AC- Audit course

*Note: (1) NECC-121 & NECC-122 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies during the semester. Student needs to qualify it but the marks will not be added in total marks.
(2) A total of 4 Credits are mandatory to earn from NPTEL/Moocs/Coursera etc during 2 years of M.Tech Program.

Discipline Specific Elective-II	1. MECT-231 Construction Economics & Financial Planning 2. MECT-232 Infrastructure Valuation and Analysis
Discipline Specific Elective-IV	1, MECT-233 Construction Personnel Management 2. MECT-234 BIM in Construction Management

Evaluation Scheme – Master of Technology (Construction Technology and Management)
Year: II / Semester: IV

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	MSCT-241P	Final Dissertation	P	RP-3	0	0	16	10			80	120	200
2.	MSCT-242P	Comprehensive Viva	P	RP-4	0	0	0	4			40	60	100
Total					**0**	**0**	**16**	**14**			**120**	**180**	**300**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, SEC- Skill Enhancement Course, DSE- Discipline Specific Elective, Th- Theory, ESE- End Semester Examination, AECC- Ability Enhancement Compulsory Course, AC- Audit course

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Format-1

Format-1

CBCS: Statement of Credit distribution (w.e.f: Session 2024-25)								
College/School: School of Engineering & Technology **Programme: M.Tech (Construction Technology and Management)** **Duration: 4 Semester Annual/Semester: Semester**						**Credit range: 70-80** **(Suggested by** **CBCS Committee)**		
Sem.	**Credit**	**Core Course/ Foundation Course Th (8 Core)**	**Ability Enhancement Compulsory Course (AECC)**	**Skill Enhancement Course (SEC)**	**Discipline Specific Elective (DSE)**	**Generic Elective (GE)**	**Research Project (RP)**	**Internship (INT)**
I	22	C-1 (4 Credit) C-2 (4 Credit) + P-1 (2 Credit) C-3 (4 Credit) C-4 (4 Credit)			DSE- 1 (4 Credit)			
II	24	C-5 (4 Credit) + P-2 (2 Credit) C-6 (4 Credit) C-7 (4 Credit) C-8 (4 Credit)		SEC-1 (2 Credit)	DSE- 2 (4 Credit)			
III	18			SEC-2 (2 Credit)	DSE- 3 (4 Credit) DSE- 4 (4 Credit)		Seminar (04 Credit) Synopsis of Dissertation (4 Credit)	
IV	14						Comprehensive Viva (4 Credit) Dissertation (10 Credit)	
Total Credits	**78**	8 (Th)*4(Credit) = 32 02 (Pr)*02(Credit) = 04 **Total = 36**		02 (Pr)*2 (Credit) = 04 **Total = 04**	04 (Th)*4 (Credit) = 16 **Total = 16**		04+04 = 08 04+ 10 = 14 **Total = 22**	

***Note: A total of 4 Credits are mandatory to earn from NPTEL/Moocs/Coursera etc. during 2 years of M.Tech Program.**

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IIMTU-NEP Implementation: (w.e.f. Session 2024-25) **Format-2**
(M. TECH IN CONSTRUCTION TECHNOLOGY AND MANAGEMENT)

Program	Year	Semester (15) weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester	Prereq uisite	Elective (For other faculty)
M. TECH IN CONSTRUCTION TECHNOLOGY AND MANAGEMENT	FIRST YEAR	SEMESTER -I	i) Core-1 (Th. 4C+ P 2C)	4 2	5 3	45 30	Construction Equipment and Management Systems Construction Management Software Lab	5		
			ii) Core-2 (Th. 4C)	4	5	45	Automation In Construction Industry	5		
			iii) Core-3 (Th. 4C)	4	5	45	Construction Laws and Regulations	5		
			iv) Core-4 (Th. 4C)	4	5	45	Research Methodology	5		
			v) DSE-1 (Th.4 C)	4	5	45	Organizational Behavior Or Modern Construction Materials and Equipment	5		
		SEMESTER - II	i) Core-5 (Th. 4C + P 2C)	4 2	5 3	45 30	Project Planning Scheduling and Control Construction Planning and Scheduling Lab	5		
			ii) Core-6 (Th. 4C)	4	5	45	Repair and Rehabilitation	5		
			iii) Core-7 (Th. 4C)	4	5	45	Construction Techniques of Deep Foundations	5		
			iv) Core-8 (Th. 4C)	4	5	45	Research and Publication Ethics	5		
			v) DSE-2 (Th. 4C)	4	5	45	Resource Management and Control In Construction Or Disaster Reduction and Management	5		
			vi) SEC-1 (P 2C)	2	3	30	Certification course (in advance technology on concern branch)	5		

Program	Year	Semester (15) weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester	Prerequisite	Elective (For other faculty)
M. TECH IN CONSTRUCTION TECHNOLOGY AND MANAGEMENT	SECOND YEAR	SEMESTER -III	i) DSE 3 (Th. 4C)	4	5	45	Construction Economics & Financial Planning Or Infrastructure Valuation and Analysis	5		
			ii) DSE 4 (Th. 4C)	4	5	45	Construction Personnel Management Or BIM in Construction Management	5		
			iii) SEC- 2 (P 2C)	2	3	30	Certification course (in advance technology on concern branch)	5		
			iv) Lab-3 (P 4C)	4	5	45	Seminar	-		
			v) RP- 1 (P 4C)	4	5	45	Synopsis of Dissertation	-		
		SEMESTER - IV	i) RP- 2 (P 10C)	10	16	60	Dissertation	-		
			ii) RP- 3 (P 4C)	4	--	--	Comprehensive Viva	-		
Program Outcome: PO1 - PO12 [ANNEXTURE-1]							**Program Specific Outcome:** PSO1 - PSO4 [ANNEXTURE-2]			
***Major Project report will be evaluated by external & internal examiners & Research topic may be selected from the main core paper.** ***A total of 4 Credits are mandatory to earn from NPTEL/Moocs/Coursera etc during 2 years of M.Tech Program.**										

ANNEXURE- I

Programme Outcome:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and Research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

ANNEXURE- II

Programme Specific Outcome:

PSO1: Developing systems, components, or processes in multiple areas of building technology and management.

PSO2: Investigate and solve complex construction management problems. Use and develop innovative tools and methods suitable for the field of building technology and management.

PSO3: Independently carry out research/investigation to solve practical problems and write/ present a substantial technical report/document.

PSO4: Apply knowledge of Construction Technology and Management in real time.

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IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG (R) **Class: M. Tech (Construction Technology and Management)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Construction Management and Equipment**
Course Code: MSCT-111	**Title: Construction Management and Equipment**

Course Objectives:

1. Main objective of this course to discuss the principles of management and their functions in construction organizations.
2. Knowledge of organization's working procedures and organizational developments and group decision making.
3. Identify quality of team leader and qualities of project leader.
4. Find out the main objective of construction equipment's.
5. We can easily deals with all management work in construction.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Principle of engineering economy, minimum cost point analysis, break-even point analysis, depreciation and depletion. Construction planning, organizing, staffing, directing, and controlling; factors influence supply and demand of human resources; Role of HR manager; personnel principles.	**9L**
II	Introduction and characteristics of management; principles and functions of management; scope, objectives, and functions of materials management; procurement and store management; materials handling management; inventory control and management; disposal of surplus materials; scientific management.	**9L**
III	Crawler and wheel tractors their functions, types and specifications; grad-ability bull dozers and their use; tractor pulled scrapers, their sizes and output; effect of grade an rolling resistance on the output of tractor pulled scrapers earth loaders; placing and compacting earth fills; power shovels; draglines functions, types, sizes, output clam shells; safe lifting capacities and working ranges cranes; hoes, trenching machine types and production rate calculation of producing rates of equipment; examples; hauling equipment with examples.	**9L**

IV	Rates for drilling rock, compressors, pile driving equipment, pile hammers, selecting a pile hammer, loss of energy due to impact, energy losses due to causes other than impact.	**9L**
V	Causes, classification, cost and measurement of an accident; safety program for construction; protective equipment; accident report; safety measure- for storage and handling of building materials, construction of elements of a building, in demolition of buildings.	**9L**

Reference Books:

1. Robert wade Brown, Practical foundation engineering handbook, McGraw Hill Publications, 1995.
2. Patrick Powers .J, Construction Dewatering: New Methods and Applications John Wiley & Sons, 1992.
3. Jerry Irvine, Advanced Construction Techniques CA Rockers, 1984.
4. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder. C, Construction Planning Equipment and Methods, Mc. Graw Hill. Singapore 1995.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To understand management fundamentals to leverage management capabilities in construction.	**L2**
CO-2	To build planning strategies and guidelines.	**L3**
CO-3	To review an organization and conduct group work within the organization.	**L1**
CO-4	To explain the beneficial use of construction equipment's.	**L2 & L4**
CO-5	To explain all management of construction.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Construction Management and Equipment (MSCT-111)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	2	0	0	2	3
CO-2	3	3	1	2	1	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	2	2	2	0	0	2	3
CO-4	3	3	2	3	2	2	3	2	2	2	1	3
CO-5	3	3	2	3	2	1	3	2	2	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG (R) **Class: M. Tech (Construction Technology and Management)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Automation in Construction Industry**
Course Code: MSCT-112	**Title: Automation in Construction Industry**

Course Objectives:

1. To give students a thorough grasp of the several automation technologies, such as robots, artificial intelligence, and building information modeling (BIM), that are utilized in the construction sector.
2. To give students the information and abilities they need to implement automation technology into various building processes in order to boost output and efficiency.
3. Evaluating the effects of automation to investigate the advantages and possible drawbacks of automation in the construction business.
4. To enhance students' problem-solving skills, assign them real-world projects and case studies that incorporate automation technology integration into building projects.
5. To prepare students for future advances in the industry and to introduce them to the newest trends and advancements in construction automation.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Building Management System (BMS)** - concept and application, automation, requirements and design considerations and their impact on the functional efficiency of the BMS, architecture, and BMS components; review and analysis of state-of-the-art in construction mechanization.	9L
II	**Sensors**- Introduction and examples of sensors found in automated equipment currently in use include field sensors, actuators, controllers, non-destructive evaluation, and data gathering.	9L
III	**Processing**- Construction sites with automated off-site systems materials processing, information processing (computer applications), case study (concrete batch plant), construction equipment (both prototype and existing), case study (concrete placement and finishing), and final product design session.	9L
IV	**HVAC**- Overview of components for HVAC (heating, ventilation, and air conditioning) systems; lighting; electrical systems; water supply and sanitary	9L

	systems; and building automation systems. Safety from fire and security -Office automation and communication system -Water pump monitoring and control - Computerized HVAC system control.	
V	**Robotics and Automation Technologies**- Prefabricating customized parts, modules, and buildings; simple technologies and single-task construction robots; robotic site automation in on-site factories.	9L

Reference Books:

1. Majrouhi Sardroud Javad, (2014), "Automation in Construction Management" Scholars' Press.
2. Javad Majrouhi Sardroud, (2011), "Automated Management of Construction Projects" LAP Lambert Academic Publishing.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Demonstrate proficiency in using various automation technologies and tools relevant to the construction industry, such as robotics and BIM.	**L2**
CO-2	Effectively apply automation technologies to real-world construction projects, improving efficiency, accuracy, and safety.	**L3**
CO-3	Analyze and evaluate the economic, social, and environmental impacts of implementing automation technologies in construction projects.	**L1**
CO-4	Gain problem-solving skills, enabling them to identify challenges and develop innovative solutions using automation technologies in construction.	**L2 & L4**
CO-5	Adapt and innovate with emerging trends and advancements in construction automation, positioning themselves as forward-thinking professionals in the industry.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Automation in Construction Industry (MSCT-112)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	2	0	0	2	3
CO-2	3	3	1	2	1	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	2	2	2	0	0	2	3

CO-4	3	3	2	3	2	2	3	2	2	2	1	3
CO-5	3	3	2	3	2	1	3	2	2	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG (R) **Class: M. Tech (Construction Technology and Management)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Construction Laws and Regulations**
Course Code: MSCT-113	**Title: Construction Laws and Regulations**

Course Objectives:

1. General principles of construction law including completion, defects, retention, certification, licensing and contract provisions.
2. Practical focus upon legal concepts applicable to the construction industry.
3. Relevant provisions of standard form building contracts.
4. Contractual relationships in the engineering and construction industry and the actions that result in disputes. Major emphasis is on the principal contractual relationships (owner- contractor, owner-architect/engineer, contractor subcontractor, and architect/engineer- consultant)
5. Legal issues and business issues that impact project management.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Construction Contracts:** Indian Contracts Act– Elements of Contracts – Types of Contracts – Features – Suitability – Design of Contract Documents– International Contract Document – Standard Contract Document– Law of Torts.	9L
II	**Tenders:** Prequalification – Bidding – Accepting – Evaluation of Tender from Technical, Contractual and Commercial Points of View – Contract Formation and Interpretation – Potential Contractual Problems – World Bank Procedures and Guidelines – Andhra Pradesh Transparency in Tenders Act.	9L
III	**Arbitration:** Comparison of Actions and Laws – Agreements – Subject Matter – Violations – Appointment of Arbitrators – Conditions of Arbitration – Powers and Duties of Arbitrator – Rules of Evidence – Enforcement of Award – Costs.	9L
IV	**Legal Requirements:** Insurance and Bonding – Laws Governing Sale, Purchase and Use of Urban and Rural Land – Land Revenue Codes – Tax Laws – Income Tax, Sales Tax, Excise and Custom Duties and	9L

	their influence on Construction Costs – Legal Requirements for Planning – Property Law – Agency Law– Local Government Laws for Approval – Statutory Regulations.	
V	**Labour Regulations:** Social Security – Welfare Legislation – Laws relating to Wages, Bonus and Industrial Disputes, Labour Administration – Insurance and Safety Regulations – Workmen's Compensation Act – Indian Factory Act – Andhra Pradesh Factory Act – Child Labour Act - Other Labour Laws.	**9L**

Reference Books:

1. Gajaria G.T., Laws Relating to Building and Engineering Contracts in India, Jimmie Hinze, Construction Contracts, McGraw Hill, 2001.
2. Joseph T. Bockrath, Contracts and the Legal Environment for Engineers and Architects, McGraw Hill, 2000.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To understand knowledge about legal Terms commonly used in the Construction Industry.	**L2**
CO-2	To explain General Structure of the U.S. Legal and Regulatory System.	**L3**
CO-3	To analyze well knowledge about construction contract, roles and responsibilities of the parties.	**L1**
CO-4	To build regulatory environment and licenses.	**L2 & L4**
CO-5	To build an environment which is avoids disputes in administrative procedures.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Construction Laws and Regulations (MSCT-113)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	2	0	0	2	3
CO-2	3	3	1	2	1	0	3	2	0	0	3	3

CO-3	3	3	0	3	0	2	2	2	0	0	2	3
CO-4	3	3	2	3	2	2	3	2	2	2	1	3
CO-5	3	3	2	3	2	1	3	2	2	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in (Construction Technology and Management)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Research Methodology**
Course Code: MSRM-111	**Title: Research Methodology**

Course Objectives:
1. To introduce with Research Methodology and its importance.
2. To study the concept of research design.
3. To determination of data collection, analysis, and their interpretation.
4. To know the types of research reports and plagiarism.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction;** Meaning of Research; Objectives; Types; Approaches Adopted in research; Significance; Methodology; different Criteria of Research; and Challenges Faced by Researchers in India; Definition and selection of the Research Problem; Importance of literature review.	9L
II	**Research Design:** Meaning; Methods of research design; Important Concepts Relating to Research Design, Types; and Basic Principles of Designs.	9L
III	**Design of Sampling:** Introduction; Sampling techniques; Errors; Sample Survey; Types of Sampling. **Data Collection:** Types of Data, Classifications of Measurement Scales, Error in Measurement Tools, Scaling, Scaling Technics, Deciding the Scale; Collection of data; Methods of Data Collection.	9L
IV	**Testing of Hypotheses:** Basic Concepts; Hypothesis Testing; Statistics and Critical Region; Procedure for Hypothesis Testing, Limitations; Interpretation of results.	9L
V	**Interpretation and Report Writing:** Introduction; Methods of Interpretation; Precaution; Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and	9L

	referencing styles, Research Journals, Indexing and citation of Journals, Intellectual property, Plagiarism.	

Reference/ Text Books:

1. C. R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques, New Age International publishers, 3rd Edition.
2. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition, SAGE, 2005.
3. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition.
4. Creswell, John W. Research design: Qualitative, quantitative, and mixed methods approach. Sage publications, 2013.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Discuss the importance of the research methodology and its technique.	**L2 & L3**
CO-2	Understand the importance of literature review in research.	**L3 &L4**
CO-3	Use different methods of research design and data collections.	**L1& L3**
CO-4	Understand the several parametric tests of hypotheses.	**L2 & L3**
CO-5	To evaluate the problems and set hypotheses.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Research Methodology (MSRM-111)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG (R) **Class: M. Tech (Construction Technology and Management)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Organizational Behavior**
Course Code: MECT-111	**Organizational Behavior**

Course Objectives:
1. To acquire knowledge of organizational behavior principles.
2. To become familiar with the construction industry's organizational structure.
3. To research the various approaches to relationships inside the company.
4. To comprehend the different organizational development and change.
5. To understand and analyze human behavior within organizational settings.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Leadership in Organizations:** Characteristics of Organizations: Organization Structure and Design, Organizational Behavior, Organizational Culture and Climate. Leadership styles and their impact on organizational effectiveness; Organizational structure: centralized vs. decentralized, matrix organizations; Organizational behavior theories: motivation, perception, attitudes.	9L
II	**Individuals in Organizations:** Individual Decision-Making; Group Dynamics: Group Behavior, Intergroup Relations and Conflict; Communication; Individual decision-making processes and biases; Group dynamics: team roles, norms, and cohesiveness; Effective communication strategies: verbal and non-verbal communication, communication barriers.	9L
III	**Motivation and Behaviour:** Motivation at Work; Designing Motivating Jobs; Theories of motivation: Maslow's hierarchy, Herzberg's two-factor theory; Job design approaches: job enrichment, job rotation Conflict management strategies: collaborative problem-solving, compromising, avoiding.	9L
IV	**Negotiation:** Principles and Tactics of Negotiation; Factors Affecting Intergroup Relations and Managing Intergroup Relations; Negotiation styles and strategies: distributive vs. integrative negotiation; Factors influencing intergroup relations: cultural differences, group dynamics;	9L

	Managing intergroup conflicts: mediation, arbitration.	
V	**Organizational Change and Development:** Managing Innovation and Technology in Changing Environments-Case Studies of OD Interventions in Mega-Construction Projects; Managing innovation and technology adoption: disruptive innovation, technology diffusion; Organizational development (OD) interventions: team building, leadership development programs.	**9L**

Reference Books:

1. Organizational Behavior, 18e (updated), Neharika Vohra Stephen P. Robbins, Timothy A. Judge.
2. Organizational Behavior, University of Minnesota Libraries Publishing.
3. A Textbook of Organizational Behavior, Dr. C B Gupta, S. Chand Publishing.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Identify key theories and concepts in organizational behavior.	**L2**
CO-2	Analyze how organizational structure influences behavior and performance.	**L4**
CO-3	Evaluate the impact of leadership styles on organizational culture.	**L3**
CO-4	Apply motivation theories to enhance employee performance and satisfaction.	**L3**
CO-5	Demonstrate effective communication and conflict resolution skills within teams.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Organizational Behavior (MECT-111)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	2	0	0	2	3
CO-2	3	3	1	2	1	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	2	2	2	0	0	2	3
CO-4	3	3	2	3	2	2	3	2	2	2	1	3
CO-5	3	3	2	3	2	1	3	2	2	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG (R) **Class: M. Tech (Construction Technology and Management)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Modern Construction Materials and Equipment**
Course Code: MECT-112	**Title: Modern Construction Materials and Equipment**

Course Objectives:

1. To comprehend the uses and characteristics of different building materials
2. Understanding the different kinds of metals and alloys
3. To comprehend how architectural materials could be used
4. To learn more about smart materials and polymer materials
5. To be familiar with the different chemical admixtures and unique concrete

Nature of Paper: Theory

Minimum Passing Marks: 40% Marks / 4 Credits 30% of ESE & 40% of total

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Reinforcement - Types - Manufacturing Process - Properties - Types of Coatings & Coatings to reinforcement; Cement - Types - Properties and Testing; Aggregate - Types - Properties and Testing.	**9L**
II	Metals and Special Steel Alloys - Cast iron, mill slab steel, water jet cut stainless steel, and tension rod assemblies - Tendon Heat Treatment GI sheets, tubes, and thin roofing components - Aluminum and its by-products.	**9L**
III	Wood and wood products; glass; floor finishes; paints; tiles; materials for acoustic absorption and thermal insulation - laminates and ornamental panels Ferro cement; architectural glass and ceramics.	**9L**
IV	Polymers: Composites and Structural Plastics Membranes made of polymers, coatings, adhesives, and non-weathering materials-Materials for Flooring and Facades- Photo catalytic Cement - Acid Etched Copper and Composite Fibers - Glazed Brick.	**9L**
V	Self-compacting, lightweight, self-dynamic, self-healing, nanotube, high density, high performance, ready-mix, and geo-polymer concrete are some examples of concrete types.	**9L**

Reference Books:

1. Kumar Mehta P. and Paulo J. M. Monteiro, (2014), Concrete: Microstructure, Properties and Materials, 4th Edition, McGraw-Hill, New Delhi.
2. Neville. A. M, (2012), Properties of Concrete, Pearson, New Delhi.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Describe the function of metals and alloys in the building sector.	**L2**
CO-2	List the many intelligent building materials that are appropriate.	**L3**
CO-3	Describe the characteristics and uses of special concrete.	**L2**
CO-4	Examine the characteristics of the most popular and cutting-edge building materials.	**L4**
CO-5	Determine the architectural materials needed for the different types of buildings.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Modern Construction Materials and Equipment (MECT-112)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	2	0	0	2	3
CO-2	3	3	1	2	1	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	2	2	2	0	0	2	3
CO-4	3	3	2	3	2	2	3	2	2	2	1	3
CO-5	3	3	2	3	2	1	3	2	2	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG (R) **Class: M. Tech (Environmental Engineering)**	**Year: I** **Semester: I**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Construction Management Software Lab**
Course Code: MSCT-111P	**Title: Construction Management Software Lab**

Course Objectives:

1. To make students to learn principles and design of structures.
2. Main object of this lab to save a time of many calculation of construction work.
3. To equip students with hands-on experience and proficiency in using industry-standard construction management software.
4. To enable students to apply construction management software tools throughout the project lifecycle.
5. To develop students' analytical and decision-making skills by utilizing construction management software to analyze project data, generate reports, and make informed decisions to optimize project outcomes.

Nature of Paper: Practical

Minimum Passing Marks/Credits : 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs. =1 Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Introduction to PRIMAVERA
Practical-2.	Developing a Work Breakdown Structure (WBS)
Practical-3.	Planning and Scheduling of Multi storied building
Practical-4.	Planning and scheduling of Road Project
Practical-5.	Prepare the resource sheet, assign and level the resource
Practical-6.	Preparing different reports available in Primavera
Practical-7.	Plot the variance graphs for the given Project
Practical-8.	Manage project resources and control costs, including adding resources, assigning them to activities, and tracking project costs against the budget.

Reference/Text Books:

1. Robert wade Brown, Practical foundation engineering hand book, McGraw Hill Publications, 1995.
2. Patrick Powers .J, Construction Dewatering: New Methods and Applications John Wiley & Sons,

1992.
3. Jerry Irvine, Advanced Construction Techniques CA Rockers, 1984.
4. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder. C, Construction Planning Equipment and Methods, Mc. Graw Hill. Singapore 1995.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Explain all the details of furniture and stairs in the form of drawings.	**L2 & L3**
CO-2	Evaluate detailed building plans with height and section height.	**L3**
CO-3	Use computer software to transfer blueprints for buildings.	**L2 & L3**
CO-4	Demonstrate proficiency in using construction management software to effectively plan, schedule, and manage construction projects.	**L2 & L3**
CO-5	Analyze project data using the software, generate insightful reports, and make informed decisions to optimize project performance and outcomes.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Construction Management Software Lab (MSCT-111P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	2	3	2	2	0	0	3
CO-2	3	3	3	3	2	2	3	1	0	0	2	3
CO-3	2	3	3	3	0	3	3	2	2	3	0	3
CO-4	3	3	3	3	2	2	3	2	0	0	2	3
CO-5	3	3	3	3	0	2	3	3	3	3	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG (R) **Class: M. Tech (Construction Technology and Management)**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Project Planning Scheduling and Control**
Course Code: MSCT-121	**Title: Project Planning Scheduling and Control**

Course Objectives:

1. Students shall be able to plan Bar Chart, CPM chart, PERT chart material requirement schedule, Manpower schedule, Machinery Schedule.
2. Student shall be able to carry out manpower resources leveling and smoothing.
3. Overview of Construction Management and Present Status of Construction Industry.
4. The course also focuses on creating a viable schedule while applying the industry standard software, Primavera P6, for project planning and scheduling.
5. Equip students with the skills and knowledge necessary to effectively plan, schedule, and control projects, ensuring that they are completed on time, within budget, and to the required quality standards.

Nature of Paper: Theory

Minimum Passing Marks: 40% Marks / 4 Credits 30% of ESE & 40% of total

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**UNDERSTANDING PROJECT MANAGEMENT:** Project manager, organization structures, organizing and staffing the project office and team	9L
II	**MANAGEMENT FUNCTIONS:** Directing, controlling, project authority, interpersonal influences, barriers, team building, communication, time management, conflicts	9L
III	**CONSTRUCTION PLANNING**: Project planning, milestone schedules, WBS, Network techniques, CPM, PERT and Prima Vera, Resources leveling and smoothing.	9L
IV	**COST CONTROL**: Understanding control, operating cycles, cost account codes, Job cost report, Projected Cost Estimates, status reporting, variance and earned value	9L
V	**PROJECT MANAGEMENT INFORMATION SYSTEM**: MIS reporting, Daily, Weekly and monthly reporting, Actual vs. Planned cost reports, Planning & Cost control document. Quality and safety.	9L

Reference Books:

1. Harold Kerzner Project Management CBS Publishers & Distributors, 2nd Edition.
2. Frank Harris & Ronald Mc Caffer Modern Construction Mgmt. Blackwell science 4th Edition.
3. Roy Pilcher Principles of Construction Management McGraw Hill London.
4. Calin M. Popescu, Chotchai Charoenngam, Project Planning, Scheduling and Control in Construction: An Encyclopedia of terms and Applications, Wiley, New York, 1995.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To create a schedule for the project, create a baseline for the schedule, consolidate scheduling resources, and Plan your baseline.	**L2**
CO-2	To understand the theory and principles of planning, scheduling and control.	**L3**
CO-3	To describe the knowledge about project outcomes with project planning, scheduling, and control.	**L1**
CO-4	To explain what risk is and improve project outcomes with project risk management.	**L2 & L4**
CO-5	To comprehend how the baseline change management process enables desired changes and protects projects from unwanted changes.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Project Planning Scheduling and Control (MSCT-121)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	2	0	0	2	3
CO-2	3	3	1	2	1	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	2	2	2	0	0	2	3
CO-4	3	3	2	3	2	2	3	2	2	2	1	3
CO-5	3	3	2	3	2	1	3	2	2	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG (R) **Class: M. Tech (Construction Technology and Management)**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Repair and Rehabilitation**
Course Code: MSCT-122	**Title: Repair and Rehabilitation**

Course Objectives:

1. Students will learn the fundamental concepts and principles behind the maintenance and rehabilitation of infrastructure.
2. Students will develop the skills to inspect, assess, and evaluate the current condition of various structures and systems, identifying common issues and potential hazards.
3. Students will gain hands-on experience with modern techniques, tools, and technologies used in the maintenance and rehabilitation processes.
4. Students will learn to design, plan, and implement effective maintenance strategies.
5. Students will assess the environmental and economic impacts of maintenance and rehabilitation activities.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**General-**Performance of construction materials and components in services; Causes of deterioration, Preventive measurements and maintenance.	9L
II	**Influence on Serviceability and Durability-**Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, and catholic protection, Principles of assessment of weathering and durability, Characteristics of materials. Diagnosis of construction failures, dealing with cracks.	9L
III	**Maintenance and Repair Strategies-**Facets of Maintenance importance of Maintenance, Preventive measures on various aspects Inspection, Assessment procedure for evaluating a damaged structure causes of deterioration - testing techniques.	9L
IV	**Materials for Repair-**Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer	9L

	concrete, Sulphur infiltrated concrete, Ferro-cement, Fiber reinforced concrete.	
V	**Techniques for Repair and Demolition-**Rust eliminators and polymers coating for rebar during repair foamed concrete, painting, water proofing, mortar and dry pack, vacuum concrete, Gunite and Shotcrete, Epoxy injection, Mortar repair for cracks, shoring and underpinning and special techniques and demolition techniques.	**9L**

Reference Books:

1. Denison Campbell, Allen and Harold Roper (1991) Concrete Structures: Materials, Maintenance and Repair, Longman Publication Group.
2. Allen R T, Edwards, S C and Shaw, J D N (2013) Repair of Concrete Structures, 2nd Edition, Springer.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To assess the health condition of structures.	**L2**
CO-2	To inspect and evaluate damaged structures.	**L3**
CO-3	To learn fundamentals of serviceability and durability of structure.	**L1**
CO-4	To understand the techniques for repairing of structures.	**L2 & L4**
CO-5	To equip students with comprehensive knowledge and practical skills required for the effective maintenance and rehabilitation of infrastructure systems.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Repair and Rehabilitation (MSCT-122)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	1	2	0	0	2	3
CO-2	3	3	1	2	1	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	2	1	2	0	0	2	3
CO-4	3	3	2	3	2	2	3	2	0	0	1	3
CO-5	3	3	2	3	2	1	3	2	0	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG (R) **Class: M. Tech (Construction Technology and Management)**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Construction Techniques of Deep Foundations**
Course Code: MSCT-123	**Title: Construction Techniques of Deep Foundations**

Course Objectives:

1. To understand the various types of deep foundations.
2. To know the various methods and techniques involved in construction of deep foundations.
3. To know the various equipment involved in construction of deep foundation.
4. To understand the management and safety requirements in construction of deep foundations.
5. To know the concept of sheet piles, coffer dams and reinforced earth walls.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction- preliminary investigations, subsurface exploration, data interpretation and estimation of various sub-soil properties; types of deep foundations; requirements for deep foundations; codal provisions on safety requirements for deep foundations.	9L
II	Bored pile classification; bored pile building techniques and sequencing; tools for drilling, boring, and pouring concrete; supervision of the piles and confirmation of quality; design factors and pile capacity.	9L
III	The categorization of driven piles; the choice of pile type and installation technique; pile pushing machinery; Building and ensuring the quality of driven piles; benefits and drawbacks of driven piles pile integrity test and damage to the piles; design factors and pile capacity.	9L
IV	Types of caissons or wells; variations in well shape; methods and construction sequences; design procedure; drilled shafts and caissons; benefits and drawbacks of having a solid foundation.	9L
V	Deep excavations and protection systems; applications of diaphragm wall; diaphragm wall construction methods; design procedure; advantages and disadvantages.	9L

Reference Books:

1. Das. B. M., (2010), Principles of Foundation Engineering, CL Engineering.
2. K. R. Arora., (2011) Soil Mechanics and Foundation Engineering, Standard publishers.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To assess the health condition of structures.	**L2**
CO-2	To inspect and evaluate damaged structures.	**L3**
CO-3	To learn fundamentals of serviceability and durability of structure.	**L1**
CO-4	To understand the techniques for repairing of structures.	**L2 & L4**
CO-5	To equip students with comprehensive knowledge and practical skills required for the effective maintenance and rehabilitation of infrastructure systems.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Construction Techniques of Deep Foundations (MSCT-123)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	2	0	0	2	3
CO-2	3	3	1	2	1	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	2	2	2	0	0	2	3
CO-4	3	3	2	3	2	2	3	2	2	2	1	3
CO-5	3	3	2	3	2	1	3	2	2	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech (Construction Technology and Management)**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Research and Publication Ethics**
Course Code: PGRPE-111	**Title: Research and Publication Ethics**

Course Objectives:
1. To understand the importance of philosophy of science and ethics.
2. To identify research misconduct and predatory publications.
3. To understand the open access publications, research metrics.
4. To understand the usage of plagiarism tools.
5. To develop effective scientific communication skills for writing research papers, proposals, and presentations.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Philosophy and Ethics:** Definition of philosophy; nature and scopes; basic concepts; different branches. Define Ethics; moral philosophy; judgements and reactions.	9L
II	**Scientific Conduct:** Ethics in science and research; Intellectual honesty and research integrity. Scientific misconducts: Falsification; Fabrication and Plagiarism; Redundant. Publications: duplicate and overlapping publications; Selective reporting and misrepresentation of data.	9L
III	**Publication Ethics:** definition; importance; standards setting initiatives and guidelines: COPE, WAME, etc.; Conflicts of interest; Publication misconduct: definition; concept; unethical behavior; types; Violation of publication ethics; authorship and contributor ship; Identification, complaints and appeals for misconduct; Predatory publisher and journals.	9L
IV	**Open Access Publishing:** Open access publications and initiatives; SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies; Software tool to identify predatory publications developed by SPPU - Journal finger / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer, Journal Suggester, etc.	9L
V	**Publication Misconduct:** Use and importance of plagiarism software like Turnitin, Urkund and other open source software tools.	9L

Reference/ Text Books:

1. Nicholas H. Steneck. Introduction to the Responsible Conduct of Research. Office of Research Integrity. 2007. Available at: https://ori.hhs.gov/sites/default/files/rcrintro.pdf
2. The Student's Guide to Research Ethics By Paul Oliver Open University Press, 2003
3. Responsible Conduct of Research By Adil E. Shamoo; David B. Resnik Oxford University Press, 2003
4. Ethics in Science Education, Research and Governance Edited by Kambadur Muralidhar, Amit Ghosh Ashok Kumar Singhvi. Indian National Science Academy, 2019. ISBN : 978-81-939482-1-7.
5. Anderson B.H., Dursaton, and Poole M.: Thesis and assignment writing, Wiley Eastern 1997.
6. Bijorn Gustavii: How to write and illustrate scientific papers? Cambridge University Press.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To understand the fundamental concepts of philosophy and ethics in scientific research.	**L2 & L3**
CO-2	To identify and address various forms of scientific misconduct, including falsification, fabrication, and plagiarism.	**L3 &L4**
CO-3	To apply publication ethics standards and manage conflicts of interest in research and publication.	**L1& L3**
CO-4	To navigate open access publishing and utilize tools to identify predatory publications.	**L2 & L3**
CO-5	To effectively use plagiarism detection software to ensure research integrity and originality.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Research and Publication Ethics (MSRE-121)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG (R) **Class: M. Tech (Construction Technology and Management)**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Resource Management and Control in Construction**
Course Code: MECT-121	**Resource Management and Control in Construction**

Course Objectives:

1. Students will be acquainted with the major construction technology as described in the subject titles listed.
2. Students will be able to describe, analyze, compare and evaluate high-rise building technology and be aware of some of the problems that can be associated with poor construction project management.
3. Understanding time management, resource allocation and leveling.
4. Understanding about the Materials and Equipment.
5. Manage all construction material.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Resource Planning:** Resource Planning, Procurement, Identification, Personnel, Planning for material, Labour, time schedule and cost control, Types of resources, manpower, Equipment, Material, Money, Time.	9L
II	**Labour Management:** Systems approach, Characteristics of resources, Utilization, measurement of actual resources required, Tools for measurement of resources, Labour, Classes of Labour, Cost of Labour, Labour schedule, optimum use Labour.	9L
III	**Materials and Equipment:** Material: Time of purchase, quantity of material, sources, Transportation, Delivery and Distribution. Equipment: Planning and selecting by optimistic choice with respect to cost, Time, Source and handling.	9L
IV	**Time Management, Resource Allocation and Leveling:** Personnel time, Management and planning, managing time on the project, forecasting the future, Critical path measuring the changes and their effects – Cash flow and cost control. Time-cost trade off, Computer application – Resource	9L

	leveling, resource list, resource allocation, Resource loading, Cumulative cost – Value Management.	
V	**Financial Resource Management and Risk Management:** Budgeting and cost estimation, Cash flow management, Financial reporting and control mechanisms, Identifying and assessing resource-related risks, Strategies for mitigating and managing risks.	**9L**

Reference Books:

1. James. A., Adrain, Quantitative Methods in Construction Management, American Elsevier Publishing Co., Inc., 1973.
2. Oxley Rand Poslcit, Management Techniques applied to the Construction Industry, Granda Publishing Ltd., 1980.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To explain construction project plans from start to finish while maintaining budgets, schedules, materials and equipment.	**L2**
CO-2	To Analyze, evaluate, and select computer applications to efficiently and effectively manage time and resource allocation and more.	**L4**
CO-3	To understand the environmental impact of engineering solutions and the need for sustainable development.	**L3**
CO-4	To Use the methods, techniques, advanced modern engineering tools, test equipment and software packages you need to practice engineering.	**L3**
CO-5	To practice the construction profession, students acquire competent technical knowledge and develop ideas that combine existing and current knowledge.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Resource Management and Control in Construction (MECT-121)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	2	0	0	2	3
CO-2	3	3	1	2	1	0	3	2	0	0	3	3

CO-3	3	3	0	3	0	2	2	2	0	0	2	3
CO-4	3	3	2	3	2	2	3	2	2	2	1	3
CO-5	3	3	2	3	2	1	3	2	2	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG (R) **Class: M. Tech (Construction Technology and Management)**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Disaster Reduction and Management**
Course Code: MECT-122	**Title: Disaster Reduction and Management**

Course Objectives:

1. To adopt various numerical method and mathematical tools for analysis of research data.
2. Learning about the natural disaster.
3. Learning the risk reduction methods of disasters.
4. To provide basic conceptual understanding of disasters and its relationships with development.
5. To gain understand approaches of Disaster Risk Reduction (DRR) and the relationship between vulnerability, disasters, disaster prevention and risk reduction.

Nature of Paper: Theory

Minimum Passing Marks/Credits/Credits: 40% Marks / 4 Credits (40% of ESE & 40% of total)

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Disaster Reduction, earthquake resistant design of structures, response spectra and design earthquake parameters, principles and philosophies, codal provisions, factors affecting damage to structures, enforcement of codal provisions, strong motion instrumentation and data processing, effective rescue operation,	**9L**
II	General planning and design aspects, conventional earthquake resistant design, seismic base isolation method, retrofitting, training and lecturing at various levels, preparedness to meet earthquake disaster, programs for public awareness, demonstrations and exhibitions, information management (safety, emergencies, management and planning, design, response, user experience problems and case studies), proper land use practices, long term disaster preparedness measures.	**9L**
III	Precautions after a major earthquake, preparedness for medical supply emergency care (first aid, home remedies), disposal of dead bodies (human and cattle), care for old and orphans. Indirect damages, damage due to ground failures, landslides, rockslides, liquefaction, fire, floods, tsunamis, release of hazardous material like poisonous gas, nuclear	**9L**

	radiation.	
IV	Disaster management, management cell, central crisis management core group, damage reconnaissance, management of relief and rehabilitation (infrastructure rehabilitation, housing rehabilitation, social rehabilitation), role of volunteers, emergency operation centers, information system, danger zone restrictions, cooperation with local authority, coordination for international relief, role of government, NGO's, business and donors, role of remote sensing in relief operations, information management and related technologies in engineering and disaster management.	**9L**
V	Design and management of disaster information resource network, Asian disaster preparedness center, regional data base, contacts and sources, cd - rom library for natural disaster management, regional disaster documentation center, non-governmental organizations.	**9L**

Reference Books:

1. Disaster Mitigation Experiences & Reflectios by Pardeep Sahni, Alka Dhameja, and Uma Medury.
2. Disaster Management Report by Department of Agriculture and Cooperation, Govt. Of India.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	**Max. Marks**
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4)Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To understand ability to integrate knowledge and analyze, assess and manage various public health aspects of disaster events at local and global levels, even when limited information is available.	**L2**
CO-2	To select the ability to describe, analyze and evaluate the environmental, social, cultural, economic, legal and organizational aspects that affect vulnerability and capacity to respond to disasters.	**L4**
CO-3	To apply the ability to manage the public health aspects of disasters.	**L3**
CO-4	To design and conduct research on different aspects of emergencies and disasters while demonstrating insight into the potential and limits of science, its role in society, and human responsibility for its use.	**L3**
CO-5	To apply knowledge of existing global frameworks and existing agreements and the role of the community in Successful disaster risk reduction.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)												
CO-PO Mapping Disaster Reduction and Management (MECT-122)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	3	2	0	2	0	0	0	2	3
CO-2	3	3	2	2	2	0	3	2	0	0	2	3
CO-3	3	3	0	3	0	2	2	2	0	0	2	3
CO-4	3	3	2	3	2	2	3	0	2	2	0	3
CO-5	3	3	2	3	2	1	3	2	2	0	0	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG (R) **Class: M. Tech (Construction Technology and Management)**	**Year: I** **Semester: II**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Construction Planning and Scheduling Lab**
Course Code: MSCT-121P	**Title: Construction Planning and Scheduling Lab**

Course Objectives:

1. To understand the management roles and recent developments to optimize solutions.
2. To know various computer applications in construction management.
3. To obtain the knowledge on modern technology in construction site and its management.
4. To integrate software applications for complex problems.
5. To develop on their own simple algorithms for any construction software.

Nature of Paper: Practical

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs. =1 Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Introduction to construction project models - analytical and numerical.
Practical-2.	Creating the Work break down structure.
Practical-3.	Application of software for project planning, scheduling & control.
Practical-4.	Activity creating and Resources allocation
Practical-5.	Programming exercises for estimation, network planning and control, LP in construction.
Practical-6.	MATLAB Programming in linear and nonlinear programming
Practical-7.	Scheduling and report preparation
Practical-8.	Working with BIM

Reference/Text Books:

1. Robert wade Brown, Practical foundation engineering hand book, McGraw Hill Publications, 1995.
2. Patrick Powers .J, Construction Dewatering: New Methods and Applications John Wiley & Sons, 1992.
3. Jerry Irvine, Advanced Construction Techniques CA Rockers, 1984.
4. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder. C, Construction Planning Equipment and

Methods, Mc. Graw Hill. Singapore 1995.		
Evaluation/Assessment Methodology		
Category	**Internal/External**	**Max. Marks**
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:		
CO-1	To describe the physical characteristics of aggregates, sources and manufacturing processes for gravels, engineering properties of aggregates, and how aggregates are classified.	**L2 & L3**
CO-2	To understand Name the constituents of Portland cement concrete and proportion concrete mix designs.	**L3**
CO-3	To explain the fieldwork and inspections necessary for successful results in concrete construction.	**L2 & L3**
CO-4	To define conduct and document laboratory investigations.	**L2 & L3**
CO-5	To create a work in small teams with individuals of diverse cultural backgrounds.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Construction Management Software Lab (MSCT-121P)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	3	2	2	3	2	2	0	0	3
CO-2	3	3	3	3	2	2	3	1	0	0	2	3
CO-3	2	3	3	3	0	3	3	2	2	3	0	3
CO-4	3	3	3	3	2	2	3	2	0	0	2	3
CO-5	3	3	3	3	0	2	3	3	3	3	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG (R) **Class: M. Tech (Construction Technology and Management)**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Construction Economics & Finance**
Course Code: MECT-231	**Construction Economics & Finance**

Course Objectives:

1. Covers the construction industry, methods of financing and accounting, and their use in managing construction projects.
2. Learn the elements of the construction industry.
3. Study the need for financial management and the means to achieve it.
4. A study of accounting methods used in construction.
5. Understand concept of financial management.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Construction accounting, Income statement. Depreciation and amortization. Engineering economics, Time value of money, discounted cash flow, NPV, ROR, PI, Bases of comparison, Incremental rate of return.	9L
II	Benefit-cost analysis, Replacement analysis, Break-even analysis. Risks and uncertainties and management decision in capital budgeting. Taxation and inflation. Work pricing, cost elements of contract, bidding and award, revision due to unforeseen causes, escalation.	9L
III	Turnkey activities, Project appraisal and project yield. Working capital management, financial plan and multiple source of finance. International finance, Budgeting and budgetary control, Performance budgeting. Appraisal through financial statements, Practical problems and case studies.	9L
IV	Equipment economics: Equipment costs, Ownership and operating costs, Buy/Rent/Lease options, Replacement analysis.	9L
V	Cost estimating: Types of Estimates, Approximate estimates – Unit estimate, Factor estimate, Cost indexes, parametric estimate, and life cycle cost. Financial management: Construction accounting, Chart of	9L

	Accounts, Financial statements – Profit and loss, Balance sheets, Financial ratios, Working capital management.	

Reference Books:

1. *Simon A. Burtonshaw-Gunn, "Risk and Financial Management in Construction", Gower Publishing, Ltd.,2009*
2. *Warneer Z, Hirsch, Urban Economics, Macmillan, New York, 1993.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To apply valuation principles to calculate the upcoming value of a lump sum payment.	**L2**
CO-2	To distinguish between discrete compounding and continuous compounding.	**L4**
CO-3	To evaluate FV and PV for flat rates with various compounding frequencies.	**L3**
CO-4	To describe present value lump sum of deferred annuity.	**L3**
CO-5	To describe interest rates for both lump sum and annuity situations.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Construction Economics & Finance (MECT-231)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	2	0	0	2	3
CO-2	3	3	1	2	1	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	2	2	2	0	0	2	3
CO-4	3	3	2	3	2	2	3	2	2	2	1	3
CO-5	3	3	2	3	2	1	3	2	2	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG (R) **Class: M. Tech (Construction Technology and Management)**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical 0**	**Subject: Infrastructure Valuation and Analysis**
Course Code: MECT-232	**Title: Infrastructure Valuation and Analysis**

Course Objectives:

1. For construction students will be able to learn site capital budgeting.
2. Students will be able to create company performance statements.
3. Students will be able to describe the main components of infrastructure, which is very important for construction.
4. Students will be able to gain fundamental knowledge of valuation principles and techniques specific to infrastructure assets, including cost, market, and income approaches.
5. Students will be able to assess the economic value and financial viability of different types of infrastructure investments.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	**T : 1**	**P : 0**	**C : 4**

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	**Contents**	**No. of Lectures Allotted**
I	**Introduction to Infrastructure Valuation** Overview of Infrastructure Assets; Types of infrastructure: transportation, utilities, social infrastructure; Importance of infrastructure valuation in economic development; Fundamental Valuation Principles; Definition and purpose of valuation; Key concepts: value, price, and cost; Valuation Approaches; Cost approach; Market approach; Income approach; Legal and Regulatory Framework; National and international standards; Role of government and regulatory bodies	**9L**
II	**Cost Approach to Valuation** Replacement and Reproduction Cost Methods; Definitions and differences; Steps involved in cost estimation; Depreciation and Obsolescence; Types of depreciation: physical, functional, and economic; Methods of calculating depreciation; Case Studies and Practical Applications; Real-world examples of cost approach valuation; Exercises and assignments	**9L**
III	**Market Approach to Valuation** Market Analysis; Identifying comparable properties; Data collection and	**9L**

	analysis; Sales Comparison Method; Adjustment factors: location, size, condition, etc.; Steps in applying the sales comparison approach; Challenges and Limitations; Availability and reliability of market data; Adjustments for unique infrastructure features; Case Studies and Practical Applications; Real-world examples of market approach valuation; Exercises and assignments	
IV	**Income Approach to Valuation** Income Generation and Projections; Revenue streams from infrastructure assets; Forecasting future cash flows; Discounted Cash Flow (DCF) Analysis; Time value of money; Calculating net present value (NPV) and internal rate of return (IRR); Risk and Uncertainty in Valuation; Identifying and quantifying risks; Sensitivity analysis; Case Studies and Practical Applications; Real-world examples of income approach valuation; Exercises and assignments	**9L**
V	**Advanced Topics and Emerging Trends in Infrastructure Valuation** Public-Private Partnerships (PPPs); Valuation of PPP projects; Risk allocation and financial structuring; Sustainable and Resilient Infrastructure; Valuation of green infrastructure; Incorporating sustainability and resilience into valuation models; Technological Innovations; Impact of digital technologies on infrastructure valuation; Use of big data, AI, and GIS in valuation; Case Studies and Future Outlook; Analysis of recent infrastructure projects and their valuations; Trends and future directions in infrastructure valuation	**9L**

Reference Books:

1. Lawrence D. Miles, Techniques of Value Analysis and Engineering, McGraw-Hill Book Company, 2009.
2. M.R.S. Murthy, Cost Analysis for Management Decisions, Tata McGraw-Hill Publishing Company Ltd., 1988.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To design of political processes for infrastructure development.	**L2**
CO-2	To understand the best tools for effective project evaluation, management, and control.	**L4**
CO-3	To compute risks and learn to manage them.	**L3**
CO-4	To implement the Best Project Financing Options.	**L3**

CO-5	To learn from experience from international/domestic project management best practices.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Infrastructure Valuation and Analysis (MECT-232)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	2	0	0	2	3
CO-2	3	3	0	1	0	0	3	0	0	0	3	3
CO-3	3	3	0	3	0	2	2	0	0	0	2	3
CO-4	3	3	2	3	2	2	3	2	2	2	0	3
CO-5	3	3	2	2	2	1	3	2	2	0	0	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG (R) **Class: M. Tech (Construction Technology and Management)**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Construction Personnel Management**
Course Code: MECT-233	**Title: Construction Personnel Management**

Course Objectives:

1. To understand the principles of project life cycle and legal and regulatory requirements.
2. To study the appraisal and assessment methods to improve the productivity of human resources.
3. To know the elements of the HR function (recruitment, selection, training and development, etc.).
4. To understand the awareness on fundamentals of human behaviour under varying stress conditions.
5. To outline the nature and sources of conflict and explain the different strategies and approaches used in the resolution of conflict.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	The project life cycle, types of construction, hiring contractors, financing constructed facilities, professional services selection, and legal and regulatory requirements are all covered in the introduction. - Project managers' role in the evolving construction industry environment.	9L
II	Project Management, contemporary developments, impact of project risks on organization, participant organization, traditional designer-constructor sequence, professional construction management, and owner-builder operation.	9L
III	Staffing Plan, Creating and Managing Human Capital - Placement and Training - Recruitment - Selection Strategies - Managerial Staffing.	9L
IV	Fundamental individual psychology; methods for designing and redesigning jobs; self-managing teams; intergroup relations; conflict in organizations; leadership and engineers as managers of decision-making features; and the importance of human relations and organizational.	9L
V	Leadership and Team Management, Leadership styles and theories, Building and leading effective teams, Communication skills, Conflict resolution, Motivation techniques, Challenges in Construction Personnel	9L

	Management, High turnover rates, Managing diversity, Coping with skill shortages, Dealing with difficult employees	

Reference Books:

1. *Khanka S. S. (2010), Organizational Behaviour, S. Chand & Company, New Delhi.*
2. *Gary Santorella, (2017), Lean Culture for the Construction Industry: Building Responsible and Committed Project Teams, Productivity Press.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Explain the principles of project life cycle and role of project managers.	**L2**
CO-2	Apply the different strategies and approaches used in the resolution of conflict.	**L3**
CO-3	Suggest labour welfare measures and the laws related to labour welfare measures.	**L2**
CO-4	Apply the different strategies and approaches used in the resolution of conflict.	**L3**
CO-5	Know about the human resources planning and policies through proper selection and training methods.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Construction Personnel Management (MECT-233)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	2	1	0	1	3
CO-2	3	3	0	2	0	0	3	1	0	0	3	3
CO-3	3	3	0	3	0	2	2	2	0	0	2	3
CO-4	3	3	1	3	2	2	3	1	2	2	1	3
CO-5	3	3	2	3	2	0	3	2	2	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG (R) **Class: M. Tech (Construction Technology and Management)**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**BIM in Construction Management**
Course Code: MECT-234	**BIM in Construction Management**

Course Objectives:

1. Equip students with the skills to proficiently use leading BIM software tools for construction project planning, design, and management.
2. Develop students' ability to foster and manage collaborative workflows among diverse project stakeholders using BIM technologies.
3. Train students to utilize BIM for optimizing construction project timelines, costs, and quality through enhanced visualization and data management.
4. Integrate sustainable design and construction practices by leveraging BIM for energy analysis, material selection, and lifecycle assessment.
5. Enable students to identify, assess, and mitigate project risks using BIM for detailed project simulations and scenario planning.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to BIM process and integrated project delivery, nD modelling, BIM software systems and guidelines to choosing different BIM software systems	**9L**
II	Introduction of modelling environment and tools, modelling approaches to producing plans, 3D models, views and sections of buildings, creating an initial sample of 3D BIM model using a BIM authoring software, Modelling of building including basic and vital elements, production of plans, views and 3D models, annotations and preparations of sheets for printing and publishing	**9L**
III	Model customizations, elements and materials, creation of internal components, external elements, massing and site modelling, Elements visibility, visualization and walkthroughs, model/information exchange and merging of models	**9L**

IV	Introduction to aspects of nD modelling, scheduling and quantity take-offs using BIM enabled systems and export to spreadsheets, Production of a 4D program in 4D BIM software, cost estimation, producing cost estimates in a 5D BIM software	**9L**
V	Basics about interoperability, Export formats and applications, exchange of information through IFC, COBie, BIM 360 Glue, Mobile BIM. Advances in BIM: Clash detection, Overview of clash detection tools, use of software to detect/resolve clashes in a BIM model, project collaboration using cloud/mobile BIM systems and common data environments.	**9L**

Reference Books:

1. Hardin, Brad and Dave McCool (2015) BIM and Construction Management: Proven Tools, Methods, and Workflows, John Wiley & Sons.
2. Eastman, C M, Chuck Eastman, Paul Teicholz, and Rafael Sacks (2011) BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors, John Wiley & Sons.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Gain expertise in the planning, designing, and managing of construction projects utilizing BIM software tools.	**L2**
CO-2	Gain more proficiency working with interdisciplinary teams by using project workflows that are integrated with BIM.	**L4**
CO-3	Learn how to apply BIM methodologies in order to decrease errors, expedite the construction process, and increase project efficiency	**L3**
CO-4	Learn how to manage and analyze data related to construction projects in order to facilitate decision-making and project optimization.	**L3**
CO-5	Comprehend and apply sustainable construction techniques and principles utilizing BIM in order to encourage environmentally conscious construction projects.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping BIM in Construction Management (MECT-234)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	3	2	0	2	2	0	0	2	3
CO-2	3	3	0	2	0	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	2	2	2	0	0	2	3
CO-4	3	3	2	3	2	2	3	2	0	0	0	3
CO-5	3	3	2	3	2	0	3	2	0	0	0	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG (R) **Class: M. Tech (Construction Technology and Management)**	**Year: I** **Semester: III**
Credits: 4 **Theory: 0** **Practical: 4**	**Subject: Seminar**
Course Code: MSCT-231P	**Title: Seminar**

Course Objectives:

1. **Enhance Research Skills:** Develop advanced research skills necessary for identifying, analyzing, and synthesizing complex information in a chosen area of study.
2. **Improve Presentation Skills:** Cultivate the ability to effectively communicate research findings and technical information through oral presentations and written reports.
3. **Foster Critical Thinking:** Encourage critical thinking and problem-solving abilities by engaging with current trends and challenges in the field.
4. **Promote Collaboration:** Enhance collaborative skills through group discussions, peer reviews, and teamwork on research projects.
5. **Encourage Lifelong Learning:** Instill a mindset of continuous learning and professional development by exploring emerging topics and technologies.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 4 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 05	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs. =1 Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
I	Research Methods and Literature Review: Techniques for conducting literature reviews and understanding research methodologies.
II	Technical Writing: Structuring and writing research papers, including citations and references.
III	Presentation Skills: Creating and delivering effective presentations, and managing audience interactions.
IV	Current Trends: Examining recent developments and technologies in the field.
V	Research Ethics: Understanding ethical considerations, avoiding plagiarism, and maintaining academic integrity.

Reference/Text Books: NA

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks

1) Internal Assessment	Internal Assessment	0
2) Presentation/Seminar/Viva-Voce(Internal)		40
3) External Practical Assessment	External Assessment	0
4) Presentation/Seminar/Viva-Voce(External)		60
5) Practical Records		0
Total:		**100**

Course Learning Outcomes:

CO-1	**Research Competence:** Students will demonstrate the ability to conduct thorough and independent research, leading to well-founded conclusions and innovative solutions.	**L2 & L3**
CO-2	**Effective Communication:** Students will exhibit strong presentation and communication skills, capable of conveying complex ideas clearly and persuasively.	**L1 & L3**
CO-3	**Analytical Proficiency:** Students will apply critical thinking and analytical skills to evaluate and interpret research findings and technical literature.	**L3 & L4**
CO-4	**Teamwork and Collaboration:** Students will effectively collaborate with peers, contributing to and benefiting from collective knowledge and diverse perspectives.	**L2 & L3**
CO-5	**Professional Growth:** Students will demonstrate an ongoing commitment to professional growth, staying informed about the latest developments in their field and applying new knowledge to their work.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Seminar (MSCT-231P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	3	3	0	2	2	0	1	2	3
CO-2	3	3	3	3	3	0	2	2	3	1	2	3
CO-3	3	3	3	3	3	2	3	2	3	2	2	3
CO-4	3	3	3	3	2	0	3	2	2	2	2	3
CO-5	3	3	3	3	0	1	3	1	2	2	2	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG (R) **Class: M. Tech (Construction Technology and Management)**	**Year: I** **Semester: III**
Credits: 4 **Theory: 0** **Practical: 4**	**Subject: Synopsis of Dissertation**
Course Code: MSCT-232P	**Title: Synopsis of Dissertation**

Course Objectives:

1. **Research Skills:** Develop advanced research abilities, including problem identification, data collection, analysis, and drawing meaningful conclusions.
2. **Innovation:** Encourage innovative solutions to engineering challenges, contributing to the field's knowledge and advancement.
3. **Technical Communication:** Enhance written and oral communication skills for effectively sharing complex technical information.
4. **Project Management:** Develop project management skills to effectively plan, execute, and complete a research project.
5. **Contributions to Engineering:** Aim to make a significant, practical, and ethical contribution to the chosen field of engineering through the dissertation research.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 4 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 05	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs. =1 Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
I	Select a Research Topic: Choose a topic that aligns with the program's guidelines.
II	Review the Literature and Gap Identification: Conduct an extensive review of existing literature to understand the current state of knowledge in your chosen area.
III	Formulate Research Questions or Objectives: Clearly define the research questions or objectives that your dissertation will address.
IV	Research Methodology: Define the methods to achieve the research objective.
V	Collect and Analyze Data: Implement your research methodology to collect data or conduct experiments. Analyze the data using appropriate statistical or analytical techniques.

Reference/Text Books: NA

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks

1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		50
3) External Practical Assessment	External Assessment	0
4) Presentation/Seminar/Viva-Voce(External)		90
5) Practical Records		0
Total:		**150**

Course Learning Outcomes:

CO-1	**Research Skills:** Develop the ability to design, execute, and report on a research project, including problem identification and methodology.	**L2 & L3**
CO-2	**Innovation and Critical Thinking:** Demonstrate creativity and critical thinking in addressing engineering challenges with innovative solutions.	**L1 & L3**
CO-3	**Communication Proficiency:** Exhibit clear technical writing skills and the ability to communicate research findings effectively.	**L2 & L3**
CO-4	**Project Management:** Manage research projects, including resource allocation and time management, to meet objectives and deadlines.	**L2 & L3**
CO-5	**Contribution to the Field:** Produce a dissertation that makes an original and meaningful contribution to the field of engineering.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Synopsis of Dissertation (MSCT-232P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	3	3	0	2	2	0	1	2	3
CO-2	3	3	3	3	3	0	2	2	3	1	2	3
CO-3	3	3	3	3	3	2	3	2	3	2	2	3
CO-4	3	3	3	3	2	0	3	2	2	2	2	3
CO-5	3	3	3	3	0	1	3	1	2	2	2	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: PG (R) **Class: M. Tech (Construction Technology and Management)**	**Year: II** **Semester: IV**
Credits: 10 **Theory: 0** **Practical: 10**	**Subject: Final Dissertation**
Course Code: MSCT-241P	**Title: Final Dissertation**

Course Objectives:

1. **Research Skills:** Develop advanced research abilities, including problem identification, data collection, analysis, and drawing meaningful conclusions.
2. **Innovation:** Encourage innovative solutions to engineering challenges, contributing to the field's knowledge and advancement.
3. **Technical Communication:** Enhance written and oral communication skills for effectively sharing complex technical information.
4. **Project Management:** Develop project management skills to effectively plan, execute, and complete a research project.
5. **Contributions to Engineering:** Aim to make a significant, practical, and ethical contribution to the chosen field of engineering through the dissertation research.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 10 Marks (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 16	C : 10

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs. =1 Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
NA	**Collect and Analyze Data:** Implement your research methodology to collect data or conduct experiments. Analyze the data using appropriate statistical or analytical techniques.
NA	**Draft the Dissertation**
NA	**Finalize and Submit:** Make any final revisions as required by sectunity committee. Prepare the final, formatted version of dissertation.

Reference/Text Books: NA

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	30
2) Presentation/Seminar/Viva-Voce(Internal)		50
3) External Practical Assessment	External	0

4) Presentation/Seminar/Viva-Voce(External)	Assessment	120
5) Practical Records		0
Total:		**200**

Course Learning Outcomes:

CO-1	**Research Skills:** Develop the ability to design, execute, and report on a research project, including problem identification and methodology.	**L2 & L3**
CO-2	**Innovation and Critical Thinking:** Demonstrate creativity and critical thinking in addressing engineering challenges with innovative solutions.	**L1 & L3**
CO-3	**Communication Proficiency:** Exhibit clear technical writing skills and the ability to communicate research findings effectively.	**L2 & L3**
CO-4	**Project Management:** Manage research projects, including resource allocation and time management, to meet objectives and deadlines.	**L2 & L3**
CO-5	**Contribution to the Field:** Produce a dissertation that makes an original and meaningful contribution to the field of engineering.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Final Dissertation (MSCT-241P)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	3	3	3	0	2	2	0	1	2	3
CO-2	3	3	3	3	3	0	2	2	3	1	2	3
CO-3	3	3	3	3	3	2	3	2	3	2	2	3
CO-4	3	3	3	3	2	0	3	2	2	2	2	3
CO-5	3	3	3	3	0	1	3	1	2	2	2	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: PG (R) **Class: M. Tech (Construction Technology and Management)**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 0** **Practical: 4**	**Subject: Comprehensive Viva**
Course Code: MSCT-242P	**Title: Comprehensive Viva**

Course Objectives:

1. **Demonstrate Research Knowledge:** Assess the student's in-depth understanding of the research, including background, methods, and results.
2. **Critical Thinking and Problem-Solving:** Evaluate the ability to think critically and apply problem-solving skills to the research.
3. **Effective Communication:** Assess the student's capacity to present complex technical information clearly and engage in scholarly discussions.
4. **Ethical Considerations:** Ensure that research adheres to ethical standards and that the student can discuss ethical implications.
5. **Overall Competency:** Determine if the student has met educational objectives, displayed mastery of the field, and demonstrated readiness for the award of the M. Tech degree.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 4 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs. =1 Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
NA	Prepare Visuals: Create clear and informative figures, tables, and charts to illustrate your data and findings.
NA	Presentation and Defense: Prepare for your dissertation defense, which may involve presenting your research findings and answering questions from your committee. Address any concerns or revisions raised during the defense.

Reference/Text Books: NA

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		30
3) External Practical Assessment	External Assessment	0
4) Presentation/Seminar/Viva-Voce(External)		60

5) Practical Records		0
Total:		**100**

Course Learning Outcomes:

CO-1	**In-Depth Understanding of Research:** The student demonstrates a deep understanding of the research topic, showcasing comprehensive knowledge of the background, literature review, research methods, and results.	**L2 & L3**
CO-2	**Critical Thinking and Problem-Solving Skills:** The student exhibits strong critical thinking abilities and effectively applies problem-solving skills in addressing questions and challenges related to the research.	**L2 & L3**
CO-3	**Effective Communication:** The student effectively communicates complex technical information, presenting research findings in a clear, organized, and engaging manner during the viva.	**L1 & L3**
CO-4	**Ethical Awareness and Implications:** The student acknowledges and discusses the ethical considerations related to their research, demonstrating an understanding of ethical principles and implications.	**L2 & L3**
CO-5	**Comprehensive Competency and Scholarly Engagement:** The student's performance in the comprehensive viva demonstrates a high level of overall competency in the field of engineering, including interdisciplinary thinking (if applicable), and readiness for the award of the M. Tech degree.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Comprehensive Viva (MSCT-242P)

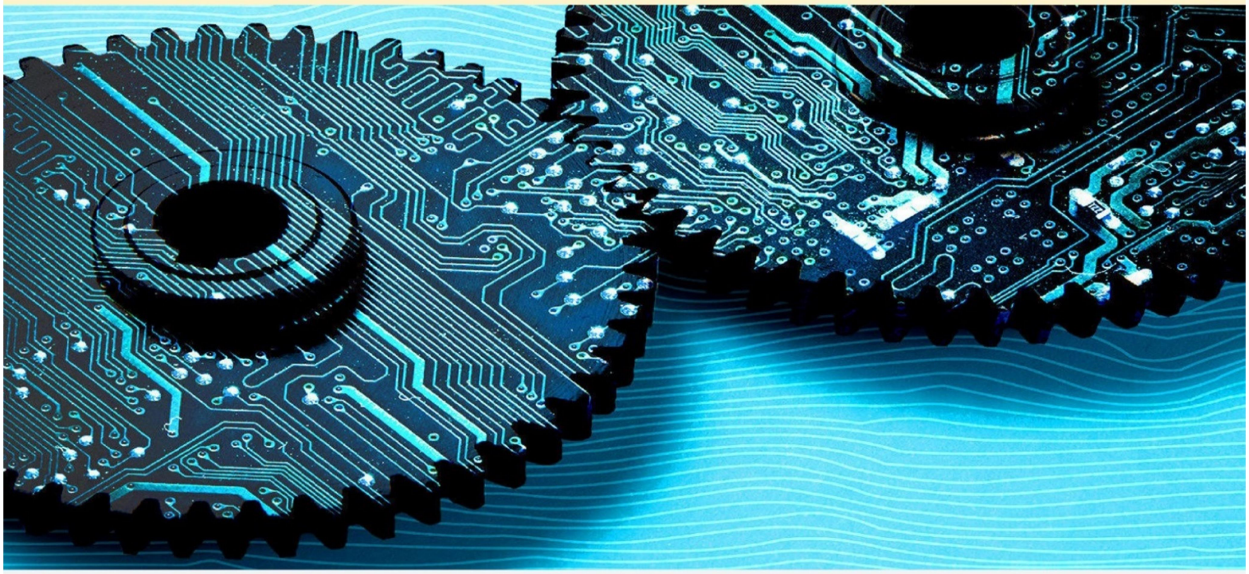
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	3	3	0	2	2	0	3	0	3
CO-2	3	3	3	3	3	0	2	2	3	3	2	3
CO-3	3	3	3	3	3	2	3	2	3	3	0	3
CO-4	3	3	3	3	3	0	3	2	2	3	1	3
CO-5	3	3	3	3	3	1	3	1	2	3	2	3

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POST GRADUATE DEGREE COURSE IN
Master of Technology (Environmental Engineering)
(Academic Session 2025-26)

Evaluation Scheme

Master of Technology (Environmental Engineering)

Evaluation Scheme – Master of Technology (Environmental Engineering)
Year: I / Semester: I

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1	MSEE-111	Air Quality and Noise Control	Th	Core-1	4	1	-	4	20	10	30	70	100
2	MSEE-112	Monitoring Environmental Quality	Th	Core-2	4	1	-	4	20	10	30	70	100
3	MSEE-113	Technology for Renewable Energy	Th	Core-3	4	1	-	4	20	10	30	70	100
4	MSRM-111	Research Methodology	Th	Core-4	4	1	-	4	20	10	30	70	100
5	MEEE-111/ MEEE-112	Departmental Elective Course-I	Th	DSE-1	4	1	-	4	20	10	30	70	100
6	MSEE-112P	Monitoring Environmental Quality Lab	P	LAB-1	0	0	2	2	10	10	20	30	50
7	NECC-111*	Industrial Visit/ Seminar/ Presentation On The Report Of Visits	P	AC	0	0	0	NC*	0	25*	25*	0	25*
8.	NECC-112*	University Social Responsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**20**	**5**	**2**	**22**	**110**	**60**	**170**	**380**	**550**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, SEC- Skill Enhancement Course, Th- Theory, ESE- End Semester Examination, AC- Audit course

*Note: (1) NECC-121 & NECC-122 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies during the semester. Student needs to qualify it but the marks will not be added in total marks
(2) A total of 4 Credits are mandatory to earn from NPTEL/Moocs/Coursera etc during 2 years of M.Tech Program.

Discipline Specific Electives -I	1. MEEE-111 Solid Waste Management 2. MEEE-112 Environmental Accountability System

Evaluation Scheme – Master of Technology (Environmental Engineering)
Year: I / Semester: II

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1	MSEE-121	Environmental Engineering: Using Biotechnology	Th	Core-5	4	1	-	4	20	10	30	70	100
2	MSEE-122	Water and Wastewater Treatment Design System	Th	Core-6	4	1	-	4	20	10	30	70	100
3	MSEE-123	Environmental Consequence Assessment	Th	Core-7	4	1	-	4	20	10	30	70	100
4	PGRPE-111	Research and Publication Ethics	Th	Core-8	4	1	-	4	20	10	30	70	100
5	MEEE-121/ MEEE-122	Departmental Elective Course-II	Th	DSE-2	4	1	-	4	20	10	30	70	100
6	MSEE-121P	Water Flow Lab	P	LAB-2	0	0	2	2	10	10	20	30	50
7	MSEC-121	Certification course (in advance technology on concern branch)	P	SEC-1	0	0	4	2	30	20	50	-	50
7	*NECC-121	Industrial Visit/ Seminar/ Presentation On The Report Of Visits	P	AC	0	0	0	NC*	0	25*	25*	0	25*
8	*NECC-122	University Social Responsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**20**	**5**	**6**	**24**	**140**	**80**	**220**	**380**	**600**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, DSE- Discipline Specific Elective, Th- Theory, ESE- End Semester Examination, AC- Audit course

*Note: NECC-121 & NECC-122 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies during the semester. Student needs to qualify it but the marks will not be added in total marks.

Discipline Specific Electives -II	1. MEEE-121 Solar Power Technology 2. MEEE-122 Energy-Saving Structure

Evaluation Scheme – Master of Technology (Environmental Engineering)
Year: II / Semester: III

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1	MEEE-231/ MEEE-232	Departmental Elective Course-III	Th	DSE-3	4	1	-	4	20	10	30	70	100
2	MEEE-233/ MEEE-234	Departmental Elective Course-IV	Th	DSE-4	4	1	-	4	20	10	30	70	100
3	MSEE-231P	Seminar	P	RP-1	0	0	5	4	-	-	40	60	100
4	MSEE-232P	Synopsis of Dissertation	P	RP-2	0	0	5	4	-	-	60	90	150
5	MSEC-231	Certification course (in advance technology on concern branch)	P	SEC-2	0	0	4	2	30	20	50	-	50
6	*NECC-231	Industrial Visit/ Seminar/Presentation on the report of visits	P	AC	0	0	0	NC*	0	25*	25*	0	25*
7	*NECC-232	University Socialesponsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**8**	**2**	**14**	**18**	**70**	**40**	**210**	**290**	**500**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, DSE- Discipline Specific Elective, Th- Theory, ESE- End Semester Examination, AC- Audit course

*Note: (1) NECC-121 & NECC-122 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies during the semester. Student needs to qualify it but the marks will not be added in total marks
(2) A total of 4 Credits are mandatory to earn from NPTEL/Moocs/Coursera etc during 2 years of M.Tech Program.

Discipline Specific Elective-II	1. MEEE-231 Industrial Emissions Management 2. MEEE-232 Instrumental Analysis Techniques
Discipline Specific Elective-IV	1, MEEE-233 Green Construction 2. MEEE-234 Climate Change: Science and Policy

Evaluation Scheme – Master of Technology (Environmental Engineering)
Year: II / Semester: IV

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	MSEE-241P	Final Dissertation	P	RP-3	0	0	16	10			80	120	200
2.	MSEE-242P	Comprehensive Viva	P	RP-4	0	0	0	4			40	60	100
Total					**0**	**0**	**16**	**14**			**120**	**180**	**300**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, SEC- Skill Enhancement Course, DSE- Discipline Specific Elective, Th- Theory, ESE- End Semester Examination, AECC- Ability Enhancement Compulsory Course, AC- Audit course

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Format-1

Format-1

CBCS: Statement of Credit distribution (w.e.f: Session 2024-25)

College/School: School of Engineering & Technology **Programme: M.Tech** **Duration: 4 Semester Annual/Semester: Semester**	**Credit range: 70-80** **(Suggested by** **CBCS Committee)**

Sem.	Credit	Core Course/ Foundation Course Th (8 Core)	Ability Enhancement Compulsory Course (AECC)	Skill Enhancement Course (SEC)	Discipline Specific Elective (DSE)	Generic Elective (GE)	Research Project (RP)	Internship (INT)
I	22	C-1 (4 Credit) C-2 (4 Credit) + P-1 (2 Credit) C-3 (4 Credit) C-4 (4 Credit)			DSE- 1 (4 Credit)			
II	24	C-5 (4 Credit) + P-2 (2 Credit) C-6 (4 Credit) C-7 (4 Credit) C-8 (4 Credit)		SEC-1 (2 Credit)	DSE- 2 (4 Credit)			
III	18			SEC-2 (2 Credit)	DSE- 3 (4 Credit) DSE- 4 (4 Credit)		Seminar (04 Credit) Synopsis of Dissertation (4 Credit)	
IV	14						Comprehensive Viva (4 Credit) Dissertation (10 Credit)	
Total Credits	**78**	8 (Th)*4(Credit) = 32 02 (Pr)*02(Credit) = 04 **Total = 36**		02 (Pr)*2 (Credit) = 04 **Total = 04**	04 (Th)*4 (Credit) = 16 **Total = 16**		04+04 = 08 04+ 10 = 14 **Total = 22**	

***Note: A total of 4 Credits are mandatory to earn from NPTEL/Moocs/Coursera etc. during 2 years of M.Tech Program.**

Format-2

IIMTU-NEP Implementation: (w.e.f. Session 2024-25) (M. TECH IN ENVIRONMENTAL ENGINEERING) **Format-2**

Program	Year	Semester (15) weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester	Prerequisite	Elective (For other faculty)
M. TECH IN ENVIRONMENTAL ENGINEERING	FIRST YEAR	SEMESTER -I	i) Core-1 (Th. 4C)	4	5	45	Air Quality and Noise Control	5		
			ii) Core-2 (Th. 4C + P 2C)	4 2	5 3	45 30	Monitoring Environmental Quality Monitoring Environmental Quality Lab	5		
			iii) Core-3 (Th. 4C)	4	5	45	Technology for Renewable Energy	5		
			iv) Core-4 (Th. 4C)	4	5	45	Research Methodology	5		
			v) DSE-1 (Th.4 C)	4	5	45	Solid Waste Management Or Environmental Accountability System	5		
		SEMESTER - II	i) Core-5 (Th. 4C)	4	5	45	Environmental Engineering: Using Biotechnology	5		
			ii) Core-6 (Th. 4C+ P 2C)	4 2	5 3	45 30	Water and Wastewater Treatment Design System Water Flow Lab	5		
			iii) Core-7 (Th. 4C)	4	5	45	Environmental Consequence Assessment	5		
			iv) Core-8 (Th. 4C)	4	5	45	Research and Publication Ethics	5		
			v) DSE-2 (Th. 4C)	4	5	45	Solar Power Technology Or Energy-Saving Structure	5		
			vi) SEC-1 (P 2C)	2	3	30	Certification course (in advance technology on concern branch)	5		

Program	Year	Semester (15) weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester	Prerequisite	Elective (For other faculty)
M. TECH IN ENVIRONMENTAL ENGINEERING	SECOND YEAR	SEMESTER -III	i) DSE 3 (Th. 4C)	4	5	45	Industrial Emissions Management Or Instrumental Analysis Techniques	5		
			ii) DSE 4 (Th. 4C)	4	5	45	Green Construction Or Climate Change: Science and Policy	5		
			iii) SEC- 2 (P 2C)	2	3	30	Certification course (in advance technology on concern branch)	5		
			iv) Lab-3 (P 4C)	4	5	45	Seminar	-		
			v) RP- 1 (P 4C)	4	5	45	Synopsis of Dissertation	-		
		SEMESTER - IV	i) RP- 2 (P 10C)	10	16	60	Dissertation	-		
			ii) RP- 3 (P 4C)	4	--	--	Comprehensive Viva	-		
Program Outcome: PO1 - PO12 [ANNEXTURE-1]							**Program Specific Outcome:** PSO1 - PSO4 [ANNEXTURE-2]			
***Major Project report will be evaluated by external & internal examiners & Research topic may be selected from the main core paper.** ***A total of 4 Credits are mandatory to earn from NPTEL/Moocs/Coursera etc during 2 years of M.Tech Program.**										

ANNEXURE- I

Programme Outcome:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and Research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

ANNEXURE- II

Programme Specific Outcome:

PSO1: Apply advanced knowledge of environmental engineering principles to solve complex environmental problems, including air and water pollution, waste management, and sustainable development.

PSO2: Demonstrate the ability to design and analyze sustainable engineering systems and processes that address environmental challenges, using modern tools and techniques.

PSO3: Engage in innovative research and development to advance environmental engineering practices, contributing to scientific knowledge and technology development.

PSO4: Deep understanding of environmental policies, regulations, and ethical responsibilities, enabling them to contribute effectively to policy formulation and compliance.

Format-3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG (R) **Class: M. Tech (Environmental Engineering)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Air Quality and Noise Control**
Course Code:MSEE-111	**Title: Air Quality and Noise Control**

Course Objectives:

1. Acquire knowledge about the types, causes, and impacts of contaminants.
2. Introduce to a wide range of research fields about air contaminants and various models for their investigation.
3. Research on the meteorological variables used to gauge air pollution.
4. Be aware of the significance of vehicular air pollution and its effects.
5. Work out engineering issues with noise control procedures.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction To Air Pollution; Sources And Effects Of Air Pollution; Classification Of Aerosols, Gases, Vapors, Natural Pollutants; Properties Of Air Pollutants.	8L
II	Metrological Factors Influencing Dispersion Of Air Pollutants; Gaussian Plume Model For Dispersion Of Air Pollutants And Its Applications; Effects On Man Material, Vegetation, And Art Treasure.	8L
III	Air Pollution Disasters; Economic Effects Of Air Pollution; Global Effects Of Air Pollution; Air Pollution Due To Automobiles And Emission Control; General Concept Of Transport Planning For Prevention Of Air Pollution; Control Technology For Particulate And Gaseous Pollutants.	8L
IV	Basics Of Noise Pollution; Measurement Of Noise; Permissible Noise Levels In Different Zones; Effects Of Noise; Wave Equations: 1-D Spherical, Cylindrical, And Planar Waves; Sound Fields, Radiation Efficiency, Acoustic Resistance, And Source Strength; Surface Vibrations Released Sound; Reverberant And Direct Field.	8L
V	Materials for insulation and sound absorption; Evaluation of insulation and sound absorption; Isolators, enclosures, and sound attenuators; Decrease in the reverberant and direct fields.	8L

Reference Books:

1. *Air pollution control theory by Martin Crawford - McGraw-Hill, 1976*
2. *Air pollution control by A.C. Stern.*
3. *Air pollution control by H.C. Perkins - McGraw-Hill, 1974*
4. *Air pollution control by Joe O. Ledbetter- Dekker, 1972*
5. *Pollution Control Technology Handbook, 2nd Edition by Karl B Schnelle Jr. and Russell F. Dunn.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Gain a brief understanding of the process to determine the kind of pollutant source.	**L2**
CO-2	Utilize dispersion models to calculate the pollution level in ambient air.	**L3**
CO-3	Gain knowledge regarding using various techniques to enhance air quality.	**L1**
CO-4	Comprehend the basic principles of noise pollution and examine the impact of noise pollution on the environment and public health.	**L2 & L4**
CO-5	Identify and develop various particle and gaseous pollution control systems.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Air Quality and Noise Control (MSEE-111)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	2	0	0	2	3
CO-2	3	3	1	2	1	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	2	2	2	0	0	2	3
CO-4	3	3	2	3	2	2	3	2	2	2	1	3
CO-5	3	3	2	3	2	1	3	2	2	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG (R) **Class: M. Tech (Environmental Engineering)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Monitoring Environmental Quality**
Course Code: MSEE-112	**Title: Monitoring Environmental Quality**

Course Objectives:

1. Educate students on the various parameters of water quality and their effects.
2. Describe in brief the steps involved in gathering and preserving samples of water and wastewater.
3. Educate students on common techniques for gathering samples and examining various environmental components, such as soil, water, wastewater, and air.
4. Provide improved analytical techniques for monitoring environmental quality.
5. Carry out brief fieldwork projects aimed at keeping an eye on the wastewater and contaminated water quality.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**General Principles:** Gathering representative samples, figuring out how often to sample, validating data, interpreting and analyzing data, using different statistical methods, implementing quality control procedures, and evaluating and managing data.	9L
II	**Metrics of Gravimetric Analysis for Solids:** Analysis of solids in water and wastewater, the measurement of turbidity, acidity, and alkalinity, the analysis of common cations and anions using a variety of chemical techniques, the measurement of COD, nitrogen, and phosphorus, and several types of titrations (acid-base, precipitation, complex metric, oxidation-reduction). The sorts of electrodes and their functioning principles are also covered.	9L
III	**Microbiological Tests:** Plate counts, confirmatory testing for different microbiological agents, MPN tests for microbial contamination, and biochemical oxygen demand (BOD) testing.	9L
IV	**Methods for Sampling Air Pollution:** methods for detecting air pollution through sampling, analysis of common chemical air pollutants and particles, and measurement of nitrogen, sulfur, and carbon monoxide oxides, hydrocarbons, and polyaromatic hydrocarbons.	9L
V	**Analytical Instrumentation:** Operation of spectrophotometric and nephelometric	9L

	techniques, ion chromatography, high-performance liquid chromatography, atomic absorption spectroscopy and its different analytical versions, CHNO/S analyzers, TOC analyzers, and other sophisticated analytical instruments.	

Reference Books:

1. *Metcalf and Eddy, (2003), Wastewater Engineering Treatment and Reuse, 4th edition, Tata Mc Graw Hill Education Private Limited, ISBN: 978-00-704-9539-5.*
2. *MN.Rao, H.V.N. Rao, (2007), Air Pollution, Tata McGraw Hill Publishing Company Limited, ISBN: 978-00-745-1871-7*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Design and implement effective sampling strategies for air, water, and soil, ensuring representative and reliable data collection for environmental monitoring.	**L3**
CO-2	Develop skills in analyzing and interpreting environmental data using statistical methods, enabling them to assess environmental quality and identify trends or anomalies.	**L2 & L4**
CO-3	Gain hands-on experience with various analytical techniques, such as spectrophotometry, chromatography, and titration, to quantify pollutants and assess environmental parameters.	**L2**
CO-4	Understand national and international environmental quality standards and regulations, enabling them to evaluate compliance and recommend necessary actions for improvement.	**L2 & L3**
CO-5	Apply theoretical knowledge to real-world scenarios, developing practical solutions for monitoring and improving environmental quality in various settings.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Monitoring Environmental Quality (MSEE-112)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	0	0	0	2	3
CO-2	3	3	1	2	2	1	3	2	2	0	3	3
CO-3	3	3	1	3	0	2	2	2	0	0	2	3
CO-4	3	3	2	3	2	2	3	0	2	2	1	3
CO-5	3	3	2	3	2	1	3	2	2	0	3	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG (R) **Class: M. Tech (Environmental Engineering)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Technology for Renewable Energy**
Course Code: MSEE-113	**Title: Technology for Renewable Energy**

Course Objectives:

1. To give students a comprehensive grasp of the theories and technological advancements of renewable energy sources.
2. To give students the abilities and information needed to develop, evaluate, and apply technologies and systems for renewable energy sources.
3. To promote knowledge of different energy sources affecting the environment.
4. To familiarize students with the regulatory, economic, and market components of renewable energy.
5. To support students' ability to innovate and conduct research in the field of renewable energy technology.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to various renewable energy sources; the availability of solar energy and the relationship between the sun and the earth; solar radiation estimation; Page-Angstrom method; flat plate collectors, solar water heating systems, and evacuated tubular concentrators. Solar air heating systems and its applications; concepts such as solar drying, cooking, desalination, solar ponds, and solar cooling. Passive heating and cooling of buildings; basics of solar concentrators and their types; principles of solar thermal power generation.	9L
II	Solar cell physics, different cell types and their manufacturing processes; applications of photovoltaic (PV) systems and the characteristics of individual cells and modules. Key performance parameters and methods for estimating module power output; PV systems optimization and configurations of these systems and the components involved, such as batteries, charge controllers, and inverters.	9L
III	Processes of Biomass conversion into energy with advantages; anaerobic digestion; different digester types. Alcohol production from biomass and biodiesel preparation-characteristics and applications. Biomass combustion	9L

	for power generation, briquetting for efficient use, and gasification processes; types of gasifiers and applications; advanced technologies in converting waste to energy.	
IV	Wind power and small hydroelectric power and their distinct characteristics; various types of windmills and components like WEGs, focusing on airfoil principles; power curves and energy output estimation through micro siting, India's wind potential. Small hydro power and identifying sites based on types, measuring head and flow, constructing discharge curves, estimating power potential, and system components.	**9L**
V	Technologies aimed at harnessing renewable energy sources such as geothermal, wave, tidal, and ocean thermal energy; innovative approaches to sustainable energy generation, utilizing the natural forces of the Earth's geology and oceans.	**9L**

Reference Books:

1. *Frank Kreith and D. Yogi Goswami (2007), Handbook of Energy Efficiency and Renewable Energy, CRC Press.*
2. *John Twidell and Tony Weir (2006), Renewable Energy Resources, 2nd Edition, Taylor & Francis, USA.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Show that they are proficient with the fundamentals, workings, and applications of a variety of renewable energy technologies.	**L3**
CO-2	Design, model, and analyze renewable energy systems by taking sustainability, feasibility, and efficiency into account.	**L3 & L4**
CO-3	Evaluate the sustainability of various energy systems and comprehend the effects that decisions about energy use have on the environment and society.	**L3**
CO-4	Well-versed in the legal, regulatory, and market systems that are pertinent to the development of renewable energy, as well as the economic and policy frameworks that underpin it.	**L2**
CO-5	Acquire the capacity to carry out investigations.	**L2**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Technology for Renewable Energy (MSEE-113)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	3	2	0	2	2	0	1	3	3
CO-2	3	3	1	2	1	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	2	2	2	0	1	2	3
CO-4	3	3	2	2	1	2	2	2	2	2	1	3
CO-5	3	3	2	2	1	0	3	2	2	0	3	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Environmental Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Research Methodology**
Course Code: MSRM-111	**Title: Research Methodology**

Course Objectives:
1. To introduce with Research Methodology and its importance.
2. To study the concept of research design.
3. To determination of data collection, analysis, and their interpretation.
4. To know the types of research reports and plagiarism.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction;** Meaning of Research; Objectives; Types; Approaches Adopted in research; Significance; Methodology; different Criteria of Research; and Challenges Faced by Researchers in India; Definition and selection of the Research Problem; Importance of literature review.	9L
II	**Research Design:** Meaning; Methods of research design; Important Concepts Relating to Research Design, Types; and Basic Principles of Designs.	9L
III	**Design of Sampling:** Introduction; Sampling techniques; Errors; Sample Survey; Types of Sampling. **Data Collection:** Types of Data, Classifications of Measurement Scales, Error in Measurement Tools, Scaling, Scaling Technics, Deciding the Scale; Collection of data; Methods of Data Collection.	9L
IV	**Testing of Hypotheses:** Basic Concepts; Hypothesis Testing; Statistics and Critical Region; Procedure for Hypothesis Testing, Limitations; Interpretation of results.	9L
V	**Interpretation and Report Writing:** Introduction; Methods of Interpretation; Precaution; Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and referencing styles, Research Journals, Indexing and citation of Journals, Intellectual property, Plagiarism.	9L

Reference/ Text Books:

1. C. R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques, New Age International publishers, 3rd Edition.
2. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition, SAGE, 2005.
3. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition.
4. Creswell, John W. Research design: Qualitative, quantitative, and mixed methods approach. Sage publications, 2013.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Discuss the importance of the research methodology and its technique.	**L2 & L3**
CO-2	Understand the importance of literature review in research.	**L3 &L4**
CO-3	Use different methods of research design and data collections.	**L1& L3**
CO-4	Understand the several parametric tests of hypotheses.	**L2 & L3**
CO-5	To evaluate the problems and set hypotheses.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Research Methodology (MSRM-111)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG (R) **Class: M. Tech (Environmental Engineering)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Solid Waste Management**
Course Code: MEEE-111	**Title: Solid Waste Management**

Course Objectives:

1. A thorough understanding of the hierarchy of solid waste management.
2. Acquire knowledge of solid waste collection, transfer, and transportation.
3. Be familiar with the construction and management of a municipal solid waste dump.
4. Be acquainted with a resource recovery design.
5. To impart expertise on the design components of solid waste management.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Solid waste management:** Objectives, Functional elements, Environmental impact of mismanagement. Solid waste: Sources, Types, Composition, Quantities, Physical, Chemical and Biological properties. Solid waste generation rate: Definition, Typical values for Indian cities, Factors affecting. Storage and collection: General considerations for waste storage at source, Types of collection systems. Transfer station: Meaning, Necessity, Location, Economic analysis. Transportation of solid waste: Means and methods, Routing of vehicles.	9L
II	**Sorting and material recovery:** Objectives, Stages of sorting, sorting operations, Guidelines for sorting for material recovery, typical material recovery facility for a commingled solid waste. Composting of solid waste: Principles, Methods, Factors affecting, Properties of compost, Vermicomposting. Energy recovery from solid waste: Parameters affecting, Biomethanation, Fundamentals of thermal processing, Pyrolysis, Incineration, Advantages and disadvantages of various technological options.	9L
III	**Landfills:** Definition, Essential components, Site selection, Land filling methods, Leachate and landfill	9L
IV	**Biomedical Waste:** Generation, identification, storage, collection, transport, treatment, common treatment and disposal, occupational hazards and safety measures. Biomedical waste legislation in India	9L

V	**Indian scenario:** Present scenario and measures to improve system for different functional elements of solid waste management system. Elements of financial management plan for solid waste system.	**9L**

Reference Books:

1. *Manual on municipal solid waste management – Government of India publication.*
2. *Integrated solid waste management – George Tchobanoglous.*
3. *Solid waste management – A. D. Bhide.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Gain knowledge about the sources of solid waste, their classification, different collection, and transport mechanisms, and the hierarchy of integrated solid waste management.	**L3**
CO-2	Design and operate energy recovery facilities.	**L3 & L4**
CO-3	Understanding the concepts and principles of Bio-Medical wastes.	**L2**
CO-4	Competent in landfill design and operation.	**L2**
CO-5	Suggest an improvement plan for managing solid waste in the context of the Indian scenario.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Solid Waste Management (MEEE-111)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	2	1	0	3	3
CO-2	3	3	1	2	1	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	2	2	2	0	0	2	3
CO-4	3	3	2	3	3	2	3	2	3	2	1	3
CO-5	3	3	2	3	2	0	3	3	2	0	3	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG (R) **Class: M. Tech (Environmental Engineering)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Environmental Accountability Systems**
Course Code: MEEE-112	**Title: Environmental Accountability Systems**

Course Objectives:

1. To comprehend the idea behind an environmental audit.
2. Acquire the knowledge and abilities required for the auditing of environmental management systems.
3. To learn about environmental management systems.
4. To use managerial abilities when they start their own business.
5. Learning the techniques for identifying and evaluating environmental aspects of an organization's activities, products, and services.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction; principles & elements of successful environmental management; Environmental management systems (EMS); organizational barriers, management responsibility, elements and extent of application, EMS structure.	9L
II	Concepts of environmental audit, objectives of audit. Types of audits; features of effective auditing. Program planning; organization of auditing program, pre-visit data collection. Audit protocol; onsite audit.	9L
III	Data sampling - inspections - evaluation and presentation; exit interview; audit report - action plan - management of audits; waste management contractor audits.	9L
IV	Life cycle assessment (LCA) and its elements: quantifying environmental impact (product life cycle phases, boundaries, functional unit, problems at each stage of the life cycle, advantages of LCA), LCA as a sustainability tool, and LCA as a strategy framework.	9L
V	ISO principles; Creating an environmental management system in line with ISO: 14000; benefits of an environmental management system; principles & elements of successful environmental management: leadership, environmental management planning, implementing an environmental management system, measurement & evaluations required for an environmental management system, environmental management	9L

	reviews & improvements; legal and regulatory concerns; Integrating ISO 9000 & ISO 14000.	

Reference Books:

1. *Renewable Energy Environment and Development- Maheswar Dayal, Konark Publishers*
2. *Planning and Implementation of ISO14001, Environmental Management System- Girdhar Gyani, Raj Publishiong House, Jaipur*
3. *ISO: 14000 Handbook- Joseph Caseio (Ed), McGraw-Hill Professional*
4. *INSIDE ISO: 14000 – The Competitive Advantage of Environmental Management- Don Sayre, St Lucie Pree*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the principles of environmental audits and put them into practice.	**L2**
CO-2	Recognize the necessity of environmental management standards.	**L4**
CO-3	Understand the key environmental issues faced by managers in different geographic and cultural contexts.	**L2**
CO-4	Get a better understanding of the moral and ethical considerations involved in achieving the efficient and sustainable use of resources.	**L2**
CO-5	Acquainted with practical skills that are pertinent, especially in the areas of impact assessment, auditing, and law.	**L2**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Environmental Accountability Systems (MEEE-112)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	2	1	0	2	3
CO-2	3	3	0	1	1	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	3	2	2	0	0	2	3
CO-4	3	3	2	3	2	2	3	2	3	2	1	3
CO-5	3	3	2	3	2	0	3	2	2	0	3	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG (R) **Class: M. Tech (Environmental Engineering)**	**Year: I** **Semester: I**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Monitoring Environmental Quality Lab**
Course Code: MSEE-112P	**Title: Monitoring Environmental Quality Lab**

Course Objectives:

1. Learn various methods and techniques used to monitor environmental parameters such as water quality, air quality, and biodiversity.
2. Gain proficiency in collecting environmental data using appropriate instruments and software.
3. Learn the principles and procedures of environmental sampling, preparation, handling, and preservation.
4. Develop fieldwork skills such as site selection, sample collection, and safety protocols required for conducting environmental monitoring activities.
5. Practice presenting findings effectively through reports, presentations, and discussions.

Nature of Paper: Practical

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs. =1 Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Determination of pH.
Practical-2.	Determination of total, suspended, dissolved volatile & fixed residue in a waste water sample.
Practical-3.	Determination of Turbidity.
Practical-4.	Determination of Carbonate, Bicarbonate, and Hydroxide Alkalinity.
Practical-5.	Determination of type and extend of Acidity.
Practical-6.	Determination of the Optimum Dose of Coagulants for Coagulation.
Practical-7.	Determination of the Hardness of water using EDTA Method.
Practical-8.	Determination of Chloride Concentration.
Practical-9.	Determination of Dissolved Oxygen (DO) and percentage saturation.
Practical-10.	Determination of Biochemical Oxygen Demand (BOD) of wastewater.
Practical-11.	Determination of Chemical Oxygen Demand (COD) of wastewater.

Reference/Text Books:

1. Metcalf and Eddy, (2003), Wastewater Engineering Treatment and Reuse, 4th edition, Tata McGraw Hill Education Private Limited, ISBN: 978-00-704-9539-5.

2. M. N. Rao, H. V. N. Rao, (2007), Air Pollution, Tata Mc Graw Hill Publishing Company Limited, ISBN: 978-00-745-1871-7.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		05
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Demonstrate competence in using monitoring equipment and techniques to assess environmental parameters accurately.	**L2 & L3**
CO-2	Interpret environmental data critically, and analyze factors influencing environmental quality.	**L3 & L4**
CO-3	Increase awareness of local and global environmental issues, understanding their implications and the importance of monitoring and managing environmental quality.	**L1 & L3**
CO-4	Apply scientific methods and principles learned in the lab to address real-world environmental challenges and propose solutions.	**L2 & L3**
CO-5	Enhance teamwork and collaboration skills through group projects and fieldwork, fostering effective communication and cooperation in environmental monitoring tasks.	**L2 & L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Monitoring Environmental Quality Lab (MSEE-112P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	2	3	2	2	0	0	3
CO-2	3	3	3	3	2	2	3	1	0	0	2	3
CO-3	2	3	3	3	1	3	3	2	2	3	0	3
CO-4	3	3	3	3	2	2	3	2	1	1	2	3
CO-5	3	3	3	3	1	3	3	3	3	3	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG (R) **Class: M. Tech (Environmental Engineering)**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Environmental Engineering: Using Biotechnology**
Course Code: MSEE-121	**Environmental Engineering: Using Biotechnology**

Course Objectives:

1. To present theories and concepts related to microbiology and biotechnology.
2. To comprehend the uses of biotechnological instruments in environmental management.
3. To familiarize oneself with the efficient application of biotechnology in environmentally sustainable waste management.
4. To comprehend different harmful substances.
5. To comprehend how different biotechnological technologies affect the environment.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Biology fundamentals: cell kinds, structures, functions, and communication during development; Development and genes: the regulation of gene expression, cell and animal body development regulation; the surroundings, the ecosystem, and its elements; biogeochemical cycles and energy Microorganisms and Environment: microorganisms are essential components of freshwater and marine habitats, terrestrial and non-terrestrial settings; Naturalized Area	**9L**
II	A review of the past in terms of biodiversity, environmental sustainability, and pollution and development; Biotechnology, Human and Environment Concepts; Benefits to Humanity; Theories and Philosophy of the Global Environment; conflict between the environment and the economy; Strategies for Sustainable Development in Environmental Management	**9L**
III	Microorganisms modified by microbial cells and enzymes, bio-removal of nutrients, and micro-algal biotechnology; interactions between diverse microbial populations and their uses in extracellular polymer function, waste bioprocessing, and environmental problem bioremediation; notions of genetic engineering applications in environmental management, plasmids, mutation, and genetically modified microbial strains.	**9L**

IV	Issues with hazardous chemical sources and classifications, halogenated and non-halogenated compounds, metals, petroleum hydrocarbons, and the consequences of toxic chemical pollution on human health; hazardous pollutants' biodegradation, detoxification processes such as oxidation reactions, dehalogenation, and metals' biotransformation; Xenobiotic Compounds: classification, origins, and risks; xenobiotic substances' recalcitrance and contributing causes; Chemical xenobiotic biodegradation	**9L**
V	Biotechnological solutions for environmental damage: subsurface environments, groundwater system decontamination, reclamation ideas, bioremediation; manufacturing of proteins, the process by which trash is bio transformed into bio fertilizers, biogas, and electrical energy; this process has an impact on health risks, odor control, physical, chemical, and microbiological aspects; the ethics of microbiological technology and its implications on the environment; Biological safety; Clean Technology: clean synthesis, industrial process ideas and applications; The process of farming as engineering.	**9L**

Reference Books:

1. *Benefield L.D. and Randall, C.W. (1980). Biological process design for wastewater treatment. Prentice-Hall. N.J.*
2. *Pelczar, M.J., Chan ECS and Krieg NR, Microbiology, Tata McGraw Hill Edition, New Delhi, India.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Learn about the biology of microorganisms.	**L2**
CO-2	Create strategies for environmental management in sustainable development.	**L3**
CO-3	Using microorganisms in environmentally friendly technology.	**L1**
CO-4	Tackle the issue of hazardous substances in the surroundings.	**L2 & L4**
CO-5	Acquire understanding of biotechnological solutions for environmental impairments.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Environmental Engineering: Using Biotechnology (MSEE-121)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	3	2	0	1	2	0	0	2	3
CO-2	3	3	0	1	1	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	3	2	2	0	0	2	3
CO-4	3	3	2	2	2	2	3	2	2	2	1	3
CO-5	3	3	2	3	2	1	3	2	2	1	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG (R) **Class: M. Tech (Environmental Engineering)**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Water and Wastewater Treatment Design System**
Course Code: MSEE-122	**Title: Water and Wastewater Treatment Design System**

Course Objectives:
1. Recognize the fundamentals and procedures of wastewater and water treatment.
2. Create and evaluate wastewater and potable water treatment systems.
3. Analyze the effects of various treatment technologies on the environment and human health.
4. Apply theoretical understanding to real-world situations when designing treatment systems.
5. Work well in groups to resolve challenging water treatment design problems.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Impacts of chemical components in wastewater; Requirement for improved wastewater treatment; Selection criteria for processes and creation of treatment flow sheets. Applications of Membrane Bio-Reactors (MBRs) / Micro-screening to remove residual suspended particles.	**9L**
II	Sources and types of phosphorus (P) and nitrogen (N), as well as procedures for removing P and N. The principles of conventional biological nitrification and DE nitrification processes. For the removal of nitrogen, sequential batch reactors (SBR) and simultaneous nitrification-DE nitrification (SND) methods are used. Novel nitrogen removal techniques, such as ANAMMOX, SHARON, CANON, etc. Principles and types of biological processes involved in the elimination of phosphorus. N and P elimination combined using biological techniques.	**9L**
III	Removal of nitrogen using chemical and physical methods- Ammonia air stripping/break point Change of ions and chlorination. Phosphorus removal using chemical addition.	**9L**
IV	Environmental harm and the economic value of natural resources; concept of total economic value; alternative methods of valuation; cost-benefit analysis and discounting.	**9L**
V	The economics of protecting biodiversity; assessing individual environmental harm; the concept of total economic value; and national	**9L**

	and international policy responses.	

Reference Books:

1. *R. K. Turner, D. W. Pearce and, I. Bateman (1994), 'Environmental Economics: An Elementary Introduction', Harvester Wheat sheaft, London.*
2. *D. W. Pearce and, R. K. Turner (1990), 'Economics of Natural Resources and the Environment', Harvester Wheat sheaf, London.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the capacity to assess water quality metrics and suggest suitable treatment procedures.	**L2**
CO-2	Design entire water and wastewater treatment systems while taking the environment, economy, and technology into account.	**L3**
CO-3	Know the rules and regulations governing the treatment of wastewater and water.	**L1**
CO-4	Know the capacity to assess and choose the best technology for certain water treatment problems.	**L2 & L4**
CO-5	Improve problem-solving abilities through practical use of water treatment design case studies and simulation technologies.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Water and Wastewater Treatment Design System (MSEE-122)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	2	0	0	2	3
CO-2	3	3	0	2	0	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	2	2	2	0	0	2	3
CO-4	3	3	1	3	2	2	3	2	2	2	1	3
CO-5	3	3	2	3	2	0	3	2	1	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG (R) **Class: M. Tech (Environmental Engineering)**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Environmental Consequence Assessment**
Course Code: MSEE-123	**Title: Environmental Consequence Assessment**

Course Objectives:

1. To understand the significance of environmental impact assessment in different engineering projects
2. To summarize the different environmental impact assessment approaches.
3. To determine the forecasting tools for evaluating the environmental impacts
4. To explain the environmental management system ideas
5. Create plans for environmental management.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Definition of Environmental Audit (EA) - types, objectives, roles and responsibility. Policies and legislation relating to environmental audits (conducting and reports). Relationship between an environmental audit and an EIA. Benefits of EA. Guidelines for EAs (General Principles, Criteria, evidence and findings, reporting). EA as environmental management tool for small scale and large scale enterprises. EA and sustainable development. Responsibilities in conducting EAs.	9L
II	The benefits of database in EAs; Future Direction of EA; Role of EIA as a tool for Sustainable Development. Concept of Carrying Capacity and Limits to growth in terms of population, Food, Resources, Capital, Energy, Land Services etc.	9L
III	Impact Assessment: Environmental, Social and Economic issues, Issues in collection of baseline data. Legislative and institutional characteristics essential for the support of a national EIA system. Steps involved in establishing and modifying a national EIA system.	9L
IV	Preliminary concept of Natural Resource Accounting, Concept of Screening, Initial environmental examination (IEE), Environmental Impact Assessment (EIA), Environmental Impact Statement (EIS), and Strategic Environmental Assessment., Rapid and Comprehensive EIA.	9L
V	Methodologies: Including Checklists, Matrices and Networks. Procedures for	9L

	Environmental Clearance by the Government of India, Mitigation Strategies, Environmental Management, Appropriate Setting of Industries and Projects for minimizing impacts. Concept of Zoning Atlas.	

Reference Books:

1. *Environmental Impact Assessment - Larry, W. Canter McGraw-Hill.*
2. *Introduction to Environmental Impact Assessment - John Glasson, R. Theriveland A. Chandwic, Routledge, Taylor & Francis.*
3. *Methods of Environmental Impact Assessment - Peter Morris, Riki Therivel, Routledge, Taylor & Francis.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Determine appropriate steps to sustainable growth.	**L2**
CO-2	Recognize the environmental impact assessment procedure.	**L3**
CO-3	Inculcate the decision-making power to propose measures based on the effects on the environment.	**L1**
CO-4	Determine the forecasting techniques for the evaluation of various environmental impacts.	**L2 & L4**
CO-5	Gain knowledge about the significance of environmental impact assessment in different engineering projects.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Environmental Consequence Assessment (MSEE-123)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	2	0	0	2	3
CO-2	3	3	0	2	0	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	2	2	1	0	0	2	3
CO-4	3	3	2	3	1	2	3	2	2	2	0	3
CO-5	3	3	2	3	2	0	3	2	2	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Environmental Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Research and Publication Ethics**
Course Code: PGRPE-111	**Research and Publication Ethics**

Course Objectives:

1. To understand the importance of philosophy of science and ethics.
2. To identify research misconduct and predatory publications.
3. To understand the open access publications, research metrics.
4. To understand the usage of plagiarism tools.
5. To develop effective scientific communication skills for writing research papers, proposals, and presentations.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Philosophy and Ethics:** Definition of philosophy; nature and scopes; basic concepts; different branches. Define Ethics; moral philosophy; judgements and reactions.	9L
II	**Scientific Conduct:** Ethics in science and research; Intellectual honesty and research integrity. Scientific misconducts: Falsification; Fabrication and Plagiarism; Redundant. Publications: duplicate and overlapping publications; Selective reporting and misrepresentation of data.	9L
III	**Publication Ethics:** definition; importance; standards setting initiatives and guidelines: COPE, WAME, etc.; Conflicts of interest; Publication misconduct: definition; concept; unethical behavior; types; Violation of publication ethics; authorship and contributor ship; Identification, complaints and appeals for misconduct; Predatory publisher and journals.	9L
IV	**Open Access Publishing:** Open access publications and initiatives; SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies; Software tool to identify predatory publications developed by SPPU - Journal finger / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer, Journal Suggester, etc.	9L
V	**Publication Misconduct:** Use and importance of plagiarism software like Turnitin, Urkund and other open source software tools.	9L

Reference/ Text Books:

1. Nicholas H. Steneck. Introduction to the Responsible Conduct of Research. Office of Research Integrity. 2007. Available at: https://ori.hhs.gov/sites/default/files/rcrintro.pdf
2. The Student's Guide to Research Ethics By Paul Oliver Open University Press, 2003
3. Responsible Conduct of Research By Adil E. Shamoo; David B. Resnik Oxford University Press, 2003
4. Ethics in Science Education, Research and Governance Edited by Kambadur Muralidhar, Amit Ghosh Ashok Kumar Singhvi. Indian National Science Academy, 2019. ISBN : 978-81-939482-1-7.
5. Anderson B.H., Dursaton, and Poole M.: Thesis and assignment writing, Wiley Eastern 1997.
6. Bijorn Gustavii: How to write and illustrate scientific papers? Cambridge University Press.
7. Bordens K.S. and Abbott, B.b.: Research Design and Methods, Mc Graw Hill, 2008.
8. Graziano, A., M., and Raulin, M.,L.: Research Methods – A Process of Inquiry, Sixth Edition, Pearson, 2007.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To understand the fundamental concepts of philosophy and ethics in scientific research.	**L2 & L3**
CO-2	To identify and address various forms of scientific misconduct, including falsification, fabrication, and plagiarism.	**L3 &L4**
CO-3	To apply publication ethics standards and manage conflicts of interest in research and publication.	**L1& L3**
CO-4	To navigate open access publishing and utilize tools to identify predatory publications.	**L2 & L3**
CO-5	To effectively use plagiarism detection software to ensure research integrity and originality.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Research and Publication Ethics (MSRE-121)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG (R) **Class: M. Tech (Environmental Engineering)**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Solar Power Technology**
Course Code: MEEE-121	**Solar Power Technology**

Course Objectives:
1. Recognize the basic ideas of solar power technology.
2. Find out about the many kinds of solar energy systems and how they are used.
3. Gain expertise in developing and implementing solar power systems.
4. Examine the effects of solar energy on the environment and the economy.
5. Examine the latest developments and inventions in solar energy technology.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Extraterrestrial radiation—the sun-earth relationship—is the source of radiation. Atmospheric attenuation; terrestrial radiation; radiation on horizontal surfaces and inclined planes; relationships between inclined surfaces and horizontal radiation; and relationships between radiation components and monthly, daily, and hourly radiation- solar diagrams Critical radiation: pyrohelio meters, pyrano meters, pyro geo meters, net pyradiometers, and sunlight recorders are instruments used to measure global, direct, and diffuse solar radiation.	**9L**
II	Design factors: categorization; flat plate collectors; liquid heating; air heating collectors; temperature distributions. The following factors affect the efficiency of flat plate collectors: heat removal rate, useful energy gained, losses in the collectors, selective surfaces, tubular solar energy collectors, analysis of concentric tube collectors, and testing of flat plate collectors.	**9L**
III	Concentric collectors: Concentration limitations - tracking mechanism - concentrator mounting - performance analysis concentrating solar concentrators: Heliostats. Solar water pump, solar chimney, solar drier, solar dehumidifier, solar still, and solar cooker are examples of solar-powered absorption air conditioning systems (water/ammonia).	**9L**
IV	Solar Process Design Simulation-TRANSYS-Active System Designphi bar, of chart method; - f chart methods for liquid and air heaters Latent heat, perceptible heat, and thermochemical storage. Materials for phase	**9L**

	change: pebble beds, organic compounds found in Glauber's salt, solar ponds, etc.	
V	Photovoltaic cells- Features of photovoltaic cells: maximum power, tracking, cell arrays, and power electric circuits for solar panel output--charge regulators, batteries, inverters, and construction principles.	**9L**

Reference Books:

1. *Duffie J.A and Beckman, W.A., "Solar Engineering of Thermal Processes", 2nd Edition, John Wiley& Sons Inc., Newyork, -1991*
2. *G.N. Tiwari. "Solar Energy: Fundamentals, Design, Modelling and Applications", Third Reprint, Narosa Publishing House, New Delhi-2006*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Explain how solar power technology works and its significance.	**L3**
CO-2	Gain proficiency in identifying and comparing various solar energy systems.	**L3 & L4**
CO-3	Gain competence in designing and proposing practical solar power projects.	**L2**
CO-4	Be capable to assess the cost-effectiveness and environmental benefits of solar energy.	**L2**
CO-5	Gain awareness of current trends and future prospects in the field of solar power technology.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Solar Power Technology (MEEE-121)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	2	0	0	3	3
CO-2	3	3	1	2	1	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	2	2	2	0	0	2	3
CO-4	3	3	2	3	2	2	3	2	2	2	1	3
CO-5	3	3	2	3	2	1	3	2	2	0	3	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG (R) **Class: M. Tech (Environmental Engineering)**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Energy Saving Structure**
Course Code: MEEE-122	**Title: Energy Saving Structure**

Course Objectives:

1. Give students a thorough understanding of energy efficiency principles and the significance of these concepts in building structures.
2. Present a range of materials and technology that help reduce energy usage during building and maintenance.
3. Gain expertise in designing and planning energy-efficient buildings and improving the energy performance of already-existing structures through retrofitting.
4. In order to pinpoint areas that require improvement, teach students how to monitor and analyze energy use in buildings.
5. Encourage an understanding of sustainable building methods and how they affect the economy and environment.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Solar energy, wind energy, passive solar heating, passive solar collection, and other renewable energy sources can all be utilized in green buildings. Macro and Microclimate, Climate and Energy, Photovoltaics, Passive Solar Strategy. Indian Examples.	9L
II	Building form including surface area, fabric heat loss, internal planning, and grouping of buildings while harnessing natural energy. Building fabrics including: doors and windows; floors; walls; masonry; ecological walling systems; and the thermal characteristics of building materials.	9L
III	Ventilation and infiltration, modeling air flow and ventilation, passive cooling, natural ventilation in commercial buildings, Principles of artificial lighting, daylight evaluation, and day lighting fresh sources of light. Building cooling, cooling by mechanical means, and passive cooling. Water-saving measures include rainwater collection and utilization, innovative systems, taps, toilets, and urinals.	9L
IV	Energy consciousness, keeping an eye on energy use, Construction Environmental Assessment - environmental standards - evaluation techniques - evaluation instruments (e.g. LEED).	9L

V	Environmental architecture principles include eco-homes, sustainable architecture, and urban design. Green building benefits: Energy conservation NBC's building code.	**9L**

Reference Books:

1. *William T. Meyer., Energy Economics and Building Design., New York: McGraw- Hill, Inc.*
2. *Public Technology, Inc. (1996). Sustainable Building Technical Manual: Green Building Design, Construction, and Operations. Public Technology, Inc., Washington, DC.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Apply energy efficiency principles to real-world building projects.	**L3**
CO-2	Demonstrate the ability to select and implement appropriate energy-saving technologies and materials.	**L3**
CO-3	Create designs for energy-efficient structures, incorporating sustainable practices and technologies.	**L2 & L3**
CO-4	Conduct energy audits and analyses to optimize building performance and reduce energy consumption.	**L2**
CO-5	Advocate for and implement sustainable practices within the construction and building maintenance industries.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Energy Saving Structure (MEEE-122)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	2	0	0	3	3
CO-2	3	3	1	2	1	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	2	2	2	0	0	2	3
CO-4	3	3	2	3	2	2	3	2	2	2	1	3
CO-5	3	3	2	3	2	1	3	2	2	0	3	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG (R) **Class: M. Tech (Environmental Engineering)**	**Year: I** **Semester: II**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Water Flow Lab**
Course Code: MSEE-121P	**Title: Water Flow Lab**

Course Objectives:

1. To educate the students in detailed design concepts related to water transmission mains, water distribution systems, and sewer networks with an emphasis on computer application.
2. Examine various modeling techniques in environmental systems with the goal of learning and utilizing computational fluid dynamics in environmental and economic modeling.
3. Students will gain knowledge from this course on which tests are appropriate for particular environmental concerns.
4. Compose technical reports and analyze lab data statistically.
5. Make use of the findings from the laboratory research to pinpoint issues, give them a numerical value, and create technical and fundamental environmental designs.

Nature of Paper: Practical

Minimum Passing Marks/: 40% Marks / 4 Credits 50% of Internal Assessment & 50% of External Assessment

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs. =1 Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Forecasting population of various cities using different cities.
Practical-2.	Detailed study of different types of valves.
Practical-3.	Detailed study of different pipe material for water supply and sewerage.
Practical-4.	Detailed study of different joints for water supply and sewerage.
Practical-5.	Design of transmission main.
Practical-6.	Design of water distribution system for housing system.
Practical-7.	Design of sanitary sewer system.
Practical-8.	Design of working drawing of manholes, drop manholes and storm water inlets.
Practical-9.	Determination of head loss.
Practical-10.	Determination of water quantity of a given locality.

Reference/Text Books:

1. *R. K. Turner, D. W. Pearceand, I. Bateman (1994), 'Environmental Economics: An Elementary Introduction', Harvester Wheat sheaft, London.*
2. *D. W. Pearceand, R. K. Turner (1990), 'Economics of Natural Resources and the Environment',*

Harvester Wheat sheaf, London.		
Evaluation/Assessment Methodology		
Category	**Internal/External**	**Max. Marks**
1) Internal Assessment	Internal Assessment	05
2) Presentation/Seminar/Viva-Voce(Internal)		15
3) External Practical Assessment	External Assessment	15
4) Presentation/Seminar/Viva-Voce(External)		10
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Acquire a basic understanding of hydraulic concepts and how water transfer systems employ them.	**L2 & L3**
CO-2	Gain expertise in the use and upkeep of instrumentation and equipment for water transfer.	**L2 & L3**
CO-3	Acquire the knowledge necessary to gather, examine, and evaluate data about the pressure and flow of water in transmission networks.	**L1 & L3**
CO-4	Develop the skills necessary to design simple water transmission systems and troubleshoot typical problems.	**L2 & L3**
CO-5	Recognize the environmental factors and safety procedures related to water transfer operations.	**L1 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Water Flow Lab (MSEE-121P)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	3	3	3	0	2	2	0	0	0	3
CO-2	3	2	1	3	3	0	2	2	3	0	2	3
CO-3	3	3	3	3	3	2	3	2	3	2	0	3
CO-4	3	3	3	3	2	0	3	2	2	2	1	3
CO-5	3	3	3	3	0	1	3	1	2	2	2	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG (R) **Class: M. Tech (Environmental Engineering)**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Industrial Emissions Management**
Course Code: MEEE-231	**Title: Industrial Emissions Management**

Course Objectives:

1. Understanding the Industrial effluent characteristics and their effects on the environment.
2. Understand the treatment and disposal alternatives of industrial wastewater.
3. To give insight into the methods and procedures employed to treat waters contaminated due to anthropogenic activities.
4. To comprehend different terminologies used in industrial wastewater treatment.
5. Acquainted with air pollution control technologies.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Water pollution laws and standards - industrial wastewater treatment, processes and equipment. Water pollution control in different Chemical industries, Air Pollution Laws, Air pollutants monitoring equipment and method of analysis, Air pollution control methods in industries, Sludge treatment and disposal.	9L
II	Engineering, ethics and environment. Ecological systems and pollution. Fundamental definitions of pollution parameters - air and water quality criteria, Standards and legislation EIA, EIS and EMP.	9L
III	Air and water pollution management through waste minimization. Industrial air pollution management: air pollution meteorology (Generation, transportation and dispersion of air pollutants). Outlines of industrial air pollution control. Selection, design and performance analysis of air pollution control equipment: gravity settling chambers, air cyclones, ESPs, filters and wet scrubbers.	9L
IV	Industrial water pollution management: Wastewater treatment processes; Pretreatment, primary and secondary treatment processes.	9L
V	Advanced wastewater treatment processes. Design of sedimentation tanks and biological treatment processes.	9L

Reference Books:

1. *Nelson & Nemerow, Industrial Water Pollution-Origin, Characteristics and Treatment, Addison, Wesley Publishing Co.*
2. *Sincero A.P. & Sincero G.A., Environmental Engineering, a Design Approach, Prentice Hall Of India.*
3. *Babbitt H.E, Sewage & Sewage Treatment, John Wiley.*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Identify different environmental issues brought on by inappropriate handling of industrial wastewater.	**L4**
CO-2	Suggest suitable methods of cleaning up pollutants from industrial wastewater.	**L3**
CO-3	Recommending specific industry-specific pollution control measures.	**L3**
CO-4	Suggest plans for minimizing air pollution from industries.	**L3**
CO-5	Overview of waste reduction in the product design of industries.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Industrial Pollution Control (MEEE-231)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	2	0	0	2	3
CO-2	3	3	1	2	1	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	2	2	2	0	0	2	3
CO-4	3	3	2	3	2	2	3	2	2	2	1	3
CO-5	3	3	2	3	2	1	3	2	2	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG (R) **Class: M. Tech (Environmental Engineering)**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Instrumental Analysis Techniques**
Course Code: MEEE-232	**Title: Instrumental Analysis Techniques**

Course Objectives:
1. To analyze the quality standards.
2. To use the appropriate instruments and minimize errors.
3. Understanding of several environmental research instruments.
4. To familiarize the student with the methods and equipment used for environmental monitoring.
5. Give thorough education on the fundamental principles of instruments.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Beer and Lambert's law, its derivation and variations, spectral shifts, chromophores, auxochromes, and the effect of solvents on absorption spectra. Equipment: Radiation sources, wavelength selectors, sample cells, detectors, photovoltaic cell, photomultiplier tube, and silicon photodiode. Applications: Single- and multi-component analysis; spectrophotometric titrations. Fluorimetry theory: concepts of electronic states (singlet, doublet, and triplet as well as internal and external conversions), quenching, quenching factors, instruments, and applications.	9L
II	Overview, basic modes of vibration in polyatomic molecules, sample preparation, and vibration influencing factors. Equipment - Radiation sources, wavelength selectors, detectors - thermocouple, thermosector, Golay cell, thermoelectric detector, and applications. Flame Photometry: Fundamentals, Interferences, Devices, and Uses. The principle, interferences, instruments, and applications of atomic absorption spectroscopy. Nephelo turbidimetry: Fundamentals, apparatus, and uses.	9L
III	Overview of Chromatography; Partition column chromatography and adsorption: technique, benefits, drawbacks, and uses. Introduction, principle, methodology, Rf values, benefits, drawbacks, and applications of thin-layer chromatography. Introduction, methods, development strategies, benefits, drawbacks, and uses of paper chromatography. Introduction to Electrophoresis: Elements that Influence Electrophoretic Mobility	9L

	Applications of paper, gel, and capillary electrophoresis techniques.	
IV	Introduction, theory, apparatus, derivation, temperature programming, benefits, drawbacks, and uses of gas chromatography. High performance liquid chromatography (HPLC): Overview, benefits, theory, equipment, and uses.	**9L**
V	Introduction, categorization, characteristics, ion exchange resins, process mechanism, variables influencing ion exchange, technique, and applications of ion exchange chromatography. Introduction, theory, equipment, and applications of gel chromatography. Overview of affinity chromatography, including theory, equipment, and applications.	**9L**

Reference Books:

1. *An introduction to climate by G.T. Trewartha*
2. *Climatology by B. Haurwitz and J.M. Austin - McGraw-Hill Inc., US*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Recognize the fundamentals of environmental engineering and the purposes of instruments.	**L1 & L2**
CO-2	Knowledge of methods and equipment related to the environment.	**L2**
CO-3	Understanding how to use chromatographic procedures.	**L2**
CO-4	Analyze environmental materials using spectroscopic methods.	**L4**
CO-5	Ability to choose an appropriate instrument for water chemical analysis.	**L1 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Instrumental Analysis Techniques (MEEE-232)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	2	0	0	2	3
CO-2	3	3	1	2	1	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	2	2	2	0	0	2	3
CO-4	3	3	2	3	2	2	3	2	2	2	1	3
CO-5	3	3	2	3	2	1	3	2	2	0	1	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG (R) **Class: M. Tech (Environmental Engineering)**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Green Construction**
Course Code: MEEE-233	**Green Construction**

Course Objectives:
1. Recognize the meaning, concept, and goals of "green building" and "cost-effective construction."
2. Use economical construction methods.
3. Use economical technologies and building techniques.
4. Recognize the Issues Caused by Global Warming
5. Explain the Green Building Concept

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Overview of the idea of economically efficient building - The availability and usage of various materials -Blocks of laterite and stone. Concrete blocks and burned bricks- Stabilized Blocks of Mud Bamboo, Fiber-Reinforced Polymer Composite, Fiber-Reinforced Cement Components, Gypsum Board, and Light Weight Beams. The accessibility of certain materials Building material recycling: brick, concrete, steel, and plastic - Environmental problems arising from building material quarrying.	9L
II	An alternative to building walls Rat Trap Bond, Flemish Bond, Arches, Panels - Cavity Walls - Ferro Cement and Ferro Concrete structures - various precast components made with these substances Panels for the walls and roof; beams; columns - Septic tanks - Water tanks - Door and window frames - Alternative systems for roofing - Filler Slab - Pre-engineered and operational building components - Composite Beam and Panel Roof - wooden goods - plastic and steel - Agency contributions - Costford - Habitat - Nirmithi Kendra.	9L
III	Meaning - Origins and Consequences The Effect of Buildings on Global Warming - Carbon Footprint: International Initiatives to Cut Carbon Emissions Definition of Green Buildings Features: - Necessity - Benefit to the environment - Economical advantages - Advantages for health and society Principal Building Energy-Efficient Areas: Embodied Energy in Materials Green Materials: Evaluate the Life Cycle Cost of Buildings and Compare the	9L

	Initial Cost of Green vs Conventional Construction.	
IV	For new construction, BREEAM, LEED, GREEN STAR, and GRIHA (Green Rating for Integrated Habitat Assessment) are used. The points system uses a differential weight age and has a purpose. Definition of "green design," "sustainable development principles in building design," "sustainable building characteristics," "sustainable material management," and "integrated lifecycle design of materials and structures" (only concepts).	**9L**
V	The Use of Solar Power in Structures; Applications of solar energy in buildings: Solar Passive Heating and Cooling Systems. Low-Powered Air Conditioning. Case studies of buildings heated and cooled by solar passive systems. Green Composite Materials for Structures Green composites concepts. Water Management: Low-Energy Approaches and Building Water Utilization. Control of Solid Wastes. Handling of Waste Water and Sullage. Green buildings and the urban environment. Built Environment and Green Cover.	**9L**

Reference Books:

1. *Harhara Iyer G, Green Building Fundamentals, Notion Press*
2. *Dr. Adv. HarshulSavla, Green Building: Principles & Practices*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Gain a comprehensive understanding of sustainable building practices and principles, including the use of eco-friendly materials and energy-efficient design.	**L2**
CO-2	Learn to assess and mitigate the environmental impacts of construction projects, ensuring adherence to green building standards and regulations.	**L3 & L4**
CO-3	Develop skills in efficient resource management, focusing on the conservation of water, energy, and materials throughout the construction process.	**L3**
CO-4	Explore and apply innovative green technologies and construction techniques that reduce carbon footprints and enhance building performance.	**L3**
CO-5	Acquire the ability to plan and execute green construction projects, integrating sustainable practices from the initial design phase to project completion.	**L2**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping Green Construction (MEEE-233)												
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	3	2	0	2	2	0	0	3	3
CO-2	3	3	1	2	1	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	2	2	2	0	0	2	3
CO-4	3	3	2	3	2	2	3	2	2	2	1	3
CO-5	3	3	2	3	2	1	3	2	2	0	3	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG (R) **Class: M. Tech (Environmental Engineering)**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Climate Change: Science and Policy**
Course Code: MEEE-234	**Climate Change: Science and Policy**

Course Objectives:

1. To provide students with an understanding of the scientific principles underlying climate change.
2. To equip students with the skills to analyze and interpret climate data.
3. To examine the diverse impacts of climate change on ecosystems, human health, agriculture, etc.
4. To explore international, national, and local climate policies, including the role of governments and NGOs.
5. To encourage critical thinking and problem-solving in the development of mitigation and adaptation strategies to address climate change challenges.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Definition, components, types of energy, possibilities for renewable energy, the origin of fossil fuels, and global and Indian resources of coal, oil, natural gas, nuclear, and geothermal energy Geothermal, wind, solar, hydro, tidal, and ocean energy, as well as nuclear, fission, and fusion energy.	9L
II	Global Energy Scenario: Patterns of energy usage across sectors, Economic implications. The Energy Scenario in India, trends of energy use in urban and rural areas, Energy's Effect on Development India's Energy Infrastructure	9L
III	A summary of the world's environmental issues, environmental deterioration as a result of energy use and production pollution due to thermal power plants, features of wind energy farms', environmental impact features of nuclear power generating and waste disposal that affect the environment, effects of hydropower generation on the environment and ecology. Guidelines for Energy Project Environmental Impact Assessments (EIAs).	9L
IV	Clean Development Mechanism [CDM], Greenhouse Gas Emissions, Ozone Layer Depletion, Global Warming, Climate Change Concerns, Climate Change in India, Kyoto Protocol, and Carbon Fund Concept of	9L

	Carbon Credit.	
V	Climate Change Policy Issues in the Himalayas, International Status of Climate Change Policies, Indian Action Plan on Climate Change, Impact of Climate Change on Glaciers, Rivers, and Water Resources.	**9L**

Reference Books:

1. *A K De (2001), Environmental Concerns, New Age Publications Pvt Ltd.*
2. *P.S.R. Murthy(1994), Power System Operation and Control, Tata McGraw-Hill Publication*

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Demonstrate a thorough understanding of the scientific concepts related to climate change.	**L3**
CO-2	Gain proficiency in using various tools and techniques to analyze climate data.	**L3 & L4**
CO-3	Assess and articulate the impacts of climate change on different sectors and regions.	**L3**
CO-4	Gain a comprehensive understanding of existing climate policies and governance structures.	**L2**
CO-5	Develop innovative solutions and strategies for climate change mitigation and adaptation.	**L3**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Climate Change: Science and Policy (MEEE-234)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	3	2	0	2	2	0	0	3	3
CO-2	3	3	1	2	1	0	3	2	0	0	3	3
CO-3	3	3	0	3	0	2	2	2	0	0	2	3
CO-4	3	3	2	3	2	2	3	2	2	2	1	3
CO-5	3	3	2	3	2	1	3	2	2	0	3	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG (R) **Class: M. Tech (Environmental Engineering)**	**Year: I** **Semester: III**
Credits: 4 **Theory: 0** **Practical: 4**	**Subject: Seminar**
Course Code: MSEE-231P	**Title: Seminar**

Course Objectives:

1. **Enhance Research Skills:** Develop advanced research skills necessary for identifying, analyzing, and synthesizing complex information in a chosen area of study.
2. **Improve Presentation Skills:** Cultivate the ability to effectively communicate research findings and technical information through oral presentations and written reports.
3. **Foster Critical Thinking:** Encourage critical thinking and problem-solving abilities by engaging with current trends and challenges in the field.
4. **Promote Collaboration:** Enhance collaborative skills through group discussions, peer reviews, and teamwork on research projects.
5. **Encourage Lifelong Learning:** Instill a mindset of continuous learning and professional development by exploring emerging topics and technologies.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 4 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	**T :** 0	**P :** 05	**C :** 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs. =1 Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
I	Research Methods and Literature Review: Techniques for conducting literature reviews and understanding research methodologies.
II	Technical Writing: Structuring and writing research papers, including citations and references.
III	Presentation Skills: Creating and delivering effective presentations, and managing audience interactions.
IV	Current Trends: Examining recent developments and technologies in the field.
V	Research Ethics: Understanding ethical considerations, avoiding plagiarism, and maintaining academic integrity.

Reference/Text Books: NA

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	0
2) Presentation/Seminar/Viva-Voce(Internal)		40

3) External Practical Assessment	External Assessment	0
4) Presentation/Seminar/Viva-Voce(External)		60
5) Practical Records		0
Total:		**100**

Course Learning Outcomes:

CO-1	**Research Competence:** Students will demonstrate the ability to conduct thorough and independent research, leading to well-founded conclusions and innovative solutions.	**L2 & L3**
CO-2	**Effective Communication:** Students will exhibit strong presentation and communication skills, capable of conveying complex ideas clearly and persuasively.	**L1 & L3**
CO-3	**Analytical Proficiency:** Students will apply critical thinking and analytical skills to evaluate and interpret research findings and technical literature.	**L3 & L4**
CO-4	**Teamwork and Collaboration:** Students will effectively collaborate with peers, contributing to and benefiting from collective knowledge and diverse perspectives.	**L2 & L3**
CO-5	**Professional Growth:** Students will demonstrate an ongoing commitment to professional growth, staying informed about the latest developments in their field and applying new knowledge to their work.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Seminar (MSEE-231P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	3	3	0	2	2	0	1	2	3
CO-2	3	3	3	3	3	0	2	2	3	1	2	3
CO-3	3	3	3	3	3	2	3	2	3	2	2	3
CO-4	3	3	3	3	2	0	3	2	2	2	2	3
CO-5	3	3	3	3	0	1	3	1	2	2	2	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG (R) **Class: M. Tech (Environmental Engineering)**	**Year: I** **Semester: III**
Credits: 4 **Theory: 0** **Practical: 4**	**Subject: Synopsis of Dissertation**
Course Code: MSEE-232P	**Title: Synopsis of Dissertation**

Course Objectives:

1. **Research Skills:** Develop advanced research abilities, including problem identification, data collection, analysis, and drawing meaningful conclusions.
2. **Innovation:** Encourage innovative solutions to engineering challenges, contributing to the field's knowledge and advancement.
3. **Technical Communication:** Enhance written and oral communication skills for effectively sharing complex technical information.
4. **Project Management:** Develop project management skills to effectively plan, execute, and complete a research project.
5. **Contributions to Engineering:** Aim to make a significant, practical, and ethical contribution to the chosen field of engineering through the dissertation research.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 4 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 05	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs. =1 Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
I	Select a Research Topic: Choose a topic that aligns with the program's guidelines.
II	Review the Literature and Gap Identification: Conduct an extensive review of existing literature to understand the current state of knowledge in your chosen area.
III	Formulate Research Questions or Objectives: Clearly define the research questions or objectives that your dissertation will address.
IV	Research Methodology: Define the methods to achieve the research objective.
V	Collect and Analyze Data: Implement your research methodology to collect data or conduct experiments. Analyze the data using appropriate statistical or analytical techniques.

Reference/Text Books: NA

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		50

3) External Practical Assessment	External Assessment	0
4) Presentation/Seminar/Viva-Voce(External)		90
5) Practical Records		0
Total:		**150**

Course Learning Outcomes:

CO-1	**Research Skills:** Develop the ability to design, execute, and report on a research project, including problem identification and methodology.	**L2 & L3**
CO-2	**Innovation and Critical Thinking:** Demonstrate creativity and critical thinking in addressing engineering challenges with innovative solutions.	**L1 & L3**
CO-3	**Communication Proficiency:** Exhibit clear technical writing skills and the ability to communicate research findings effectively.	**L2 & L3**
CO-4	**Project Management:** Manage research projects, including resource allocation and time management, to meet objectives and deadlines.	**L2 & L3**
CO-5	**Contribution to the Field:** Produce a dissertation that makes an original and meaningful contribution to the field of engineering.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Synopsis of Dissertation (MSEE-232P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	3	3	0	2	2	0	1	2	3
CO-2	3	3	3	3	3	0	2	2	3	1	2	3
CO-3	3	3	3	3	3	2	3	2	3	2	2	3
CO-4	3	3	3	3	2	0	3	2	2	2	2	3
CO-5	3	3	3	3	0	1	3	1	2	2	2	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: PG (R) **Class: M. Tech (Environmental Engineering)**	**Year: II** **Semester: IV**
Credits: 10 **Theory: 0** **Practical: 10**	**Subject: Final Dissertation**
Course Code: MSEE-241P	**Title: Final Dissertation**

Course Objectives:

1. **Research Skills:** Develop advanced research abilities, including problem identification, data collection, analysis, and drawing meaningful conclusions.
2. **Innovation:** Encourage innovative solutions to engineering challenges, contributing to the field's knowledge and advancement.
3. **Technical Communication:** Enhance written and oral communication skills for effectively sharing complex technical information.
4. **Project Management:** Develop project management skills to effectively plan, execute, and complete a research project.
5. **Contributions to Engineering:** Aim to make a significant, practical, and ethical contribution to the chosen field of engineering through the dissertation research.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 10 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 16	C : 10

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs. =1 Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
NA	**Collect and Analyze Data:** Implement your research methodology to collect data or conduct experiments. Analyze the data using appropriate statistical or analytical techniques.
NA	**Draft the Dissertation**
NA	**Finalize and Submit:** Make any final revisions as required by sectunity committee. Prepare the final, formatted version of dissertation.

Reference/Text Books: NA

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	30
2) Presentation/Seminar/Viva-Voce(Internal)		50
3) External Practical Assessment	External Assessment	0
4) Presentation/Seminar/Viva-Voce(External)		120

5) Practical Records		0
Total:		**200**

Course Learning Outcomes:		
CO-1	**Research Skills:** Develop the ability to design, execute, and report on a research project, including problem identification and methodology.	**L2 & L3**
CO-2	**Innovation and Critical Thinking:** Demonstrate creativity and critical thinking in addressing engineering challenges with innovative solutions.	**L1 & L3**
CO-3	**Communication Proficiency:** Exhibit clear technical writing skills and the ability to communicate research findings effectively.	**L2 & L3**
CO-4	**Project Management:** Manage research projects, including resource allocation and time management, to meet objectives and deadlines.	**L2 & L3**
CO-5	**Contribution to the Field:** Produce a dissertation that makes an original and meaningful contribution to the field of engineering.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Final Dissertation (MSEE-241P)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	3	3	3	0	2	2	0	1	2	3
CO-2	3	3	3	3	3	0	2	2	3	1	2	3
CO-3	3	3	3	3	3	2	3	2	3	2	2	3
CO-4	3	3	3	3	2	0	3	2	2	2	2	3
CO-5	3	3	3	3	0	1	3	1	2	2	2	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: PG (R) **Class: M. Tech (Environmental Engineering)**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 0** **Practical: 4**	**Subject: Comprehensive Viva**
Course Code: MSEE-242P	**Title: Comprehensive Viva**

Course Objectives:

1. **Demonstrate Research Knowledge:** Assess the student's in-depth understanding of the research, including background, methods, and results.
2. **Critical Thinking and Problem-Solving:** Evaluate the ability to think critically and apply problem-solving skills to the research.
3. **Effective Communication:** Assess the student's capacity to present complex technical information clearly and engage in scholarly discussions.
4. **Ethical Considerations:** Ensure that research adheres to ethical standards and that the student can discuss ethical implications.
5. **Overall Competency:** Determine if the student has met educational objectives, displayed mastery of the field, and demonstrated readiness for the award of the M. Tech degree.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 4 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs. =1 Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
NA	Prepare Visuals: Create clear and informative figures, tables, and charts to illustrate your data and findings.
NA	Presentation and Defense: Prepare for your dissertation defense, which may involve presenting your research findings and answering questions from your committee. Address any concerns or revisions raised during the defense.

Reference/Text Books: NA

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		30
3) External Practical Assessment	External Assessment	0
4) Presentation/Seminar/Viva-Voce(External)		60
5) Practical Records		0

Total:		**100**
Course Learning Outcomes:		
CO-1	**In-Depth Understanding of Research:** The student demonstrates a deep understanding of the research topic, showcasing comprehensive knowledge of the background, literature review, research methods, and results.	**L2 & L3**
CO-2	**Critical Thinking and Problem-Solving Skills:** The student exhibits strong critical thinking abilities and effectively applies problem-solving skills in addressing questions and challenges related to the research.	**L2 & L3**
CO-3	**Effective Communication:** The student effectively communicates complex technical information, presenting research findings in a clear, organized, and engaging manner during the viva.	**L1 & L3**
CO-4	**Ethical Awareness and Implications:** The student acknowledges and discusses the ethical considerations related to their research, demonstrating an understanding of ethical principles and implications.	**L2 & L3**
CO-5	**Comprehensive Competency and Scholarly Engagement:** The student's performance in the comprehensive viva demonstrates a high level of overall competency in the field of engineering, including interdisciplinary thinking (if applicable), and readiness for the award of the M. Tech degree.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Comprehensive Viva (MSEE-242P)

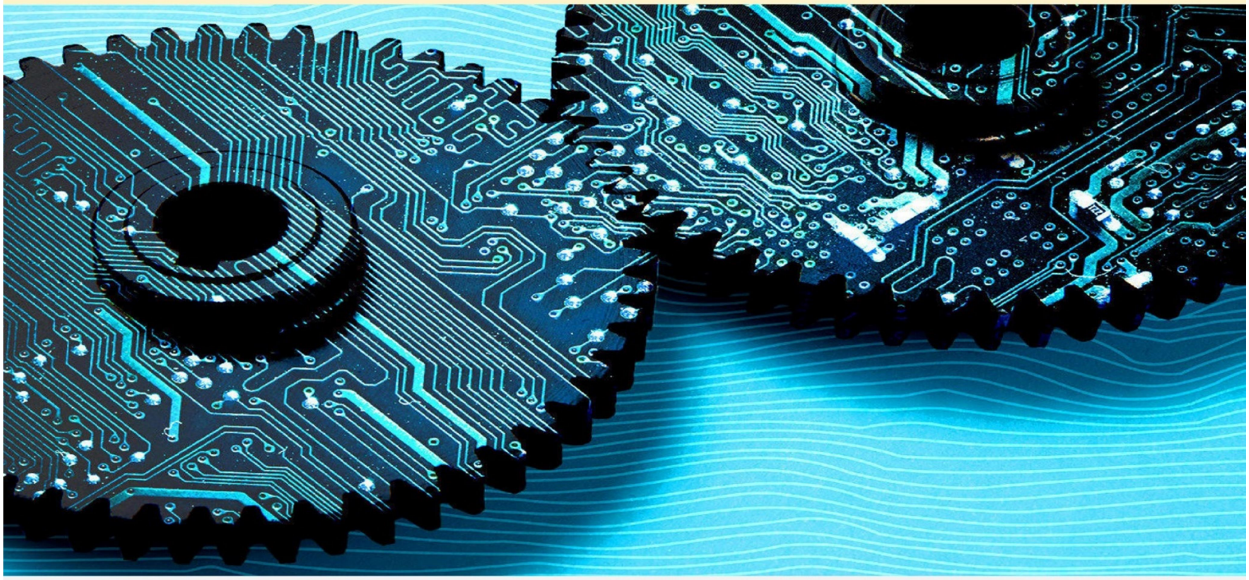
	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	3	3	3	0	2	2	0	3	0	3
CO-2	3	3	3	3	3	0	2	2	3	3	2	3
CO-3	3	3	3	3	3	2	3	2	3	3	0	3
CO-4	3	3	3	3	3	0	3	2	2	3	1	3
CO-5	3	3	3	3	3	1	3	1	2	3	2	3

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SCHOOL OF ENGINEERING & TECHNOLOGY

ACADEMIC HAND BOOK



+91-9897474598 www.iimtu.edu.in O-Pocket, Ganga Nagar, Mawana Road, Meerut-250001

POST GRADUATE DEGREE COURSE IN
Master of Technology (Structural Engineering)
(Academic Session 2025-26)

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Evaluation Scheme

Master of Technology (Structural Engineering)

Evaluation Scheme – Master of Technology (Structural Engineering)
Year: I / Semester: I

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1	MSSE-111	Analysis of reinforced Structures	Th	Core-1	4	1	-	4	20	10	30	70	100
2	MSSE-112	Advanced analysis of Concrete Design	Th	Core-2	4	1	-	4	20	10	30	70	100
3	MSSE-113	Theory of Elasticity and Plasticity	Th	Core-3	4	1	-	4	20	10	30	70	100
4	MSRM-111	Research Methodology	Th	Core-4	4	1	-	4	20	10	30	70	100
5	MESE-111/ MESE-112	Departmental Elective Course-I	Th	DSE-1	4	1	-	4	20	10	30	70	100
6	MSSE-112P	Mix Design Lab	P	LAB-1	0	0	2	2	10	10	20	30	50
7	NECC-111*	Industrial Visit/ Seminar/ Presentation On The Report Of Visits	P	AC	0	0	0	NC*	0	25*	25*	0	25*
8.	NECC-112*	University Social Responsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**20**	**5**	**2**	**22**	**110**	**60**	**170**	**380**	**550**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, SEC- Skill Enhancement Course, Th- Theory, ESE- End Semester Examination, AC- Audit course

*Note: (1) NECC-121 & NECC-122 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies during the semester. Student needs to qualify it but the marks will not be added in total marks
(2) A total of 4 Credits are mandatory to earn from NPTEL/Moocs/Coursera etc during 2 years of M.Tech Program.

Discipline Specific Electives -I	1. MESE-111 Composite material and Structure 2. MESE-112 Computer Oriented Numerical Methods

Evaluation Scheme – Master of Technology (Structural Engineering)
Year: I / Semester: II

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1	MSSE-121	Finite Element Analysis	Th	Core-5	4	1	-	4	20	10	30	70	100
2.	MSSE-122	Pre-stressed Concrete Structures	Th	Core-6	4	1	-	4	20	10	30	70	100
3	MSSE-123	Dynamic analysis of structures	Th	Core-7	4	1	-	4	20	10	30	70	100
4	PGRPE-111	Research and Publication Ethics	Th	Core-8	4	1	-	4	20	10	30	70	100
5	MESE-121/ MESE-122	Departmental Elective Course-II	Th	DSE-2	4	1	-	4	20	10	30	70	100
6	MSSE-121P	Finite Element Analysis Lab	P	LAB-2	0	0	2	2	10	10	20	30	50
7	MSEC-121	Certification course (in advance technology on concern branch)	P	SEC-1	0	0	4	2	30	20	50	-	50
7	*NECC-121	Industrial Visit/ Seminar/ Presentation On The Report Of Visits	P	AC	0	0	0	NC*	0	25*	25*	0	25*
8	*NECC-122	University Social Responsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**20**	**5**	**6**	**24**	**140**	**80**	**220**	**380**	**600**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, DSE- Discipline Specific Elective, Th- Theory, ESE- End Semester Examination, AC- Audit course

*Note: NECC-121 & NECC-122 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies during the semester. Student needs to qualify it but the marks will not be added in total marks

Discipline Specific Electives -II	1. MESE-121 Machine Learning Methods 2. MESE-122 Optimization Techniques

Evaluation Scheme – Master of Technology (Structural Engineering)
Year: II / Semester: III

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1	MESE-231/ MESE-232	Departmental Elective Course-III	Th	DSE-3	4	1	-	4	20	10	30	70	100
2	MESE-233/ MESE-234	Departmental Elective Course-IV	Th	DSE-4	4	1	-	4	20	10	30	70	100
3	MSSE-231P	Seminar	P	RP-1	0	0	5	4			40	60	100
4	MSSE-232P	Synopsis of Dissertation	P	RP-2	0	0	5	4			60	90	150
5	MSEC-231	Certification course (in advance technology on concern branch)	P	SEC-2	0	0	4	2	30	20	50	-	50
6	*NECC-231	Industrial Visit/ Seminar/ Presentation on the report of visits	P	AC	0	0	0	NC*	0	25*	25*	0	25*
7	*NECC-232	University Social Responsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**8**	**2**	**14**	**18**	**70**	**40**	**210**	**290**	**500**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, DSE- Discipline Specific Elective, Th- Theory, ESE- End Semester Examination, AC- Audit course

*Note: (1) NECC-231 & NECC-232 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies during the semester. Student needs to qualify it but the marks will not be added in total marks.
(2) A total of 4 Credits are mandatory to earn from NPTEL/Moocs/Coursera etc during 2 years of M.Tech Program.

Discipline Specific Elective-II	1. MESE-231 Structural Stability 2. MESE-232 Bridge Engineering
Discipline Specific Elective-IV	1, MESE-233 Design of Masonry Structures 2. MESE-234 Structural Health Monitoring

Evaluation Scheme – Master of Technology (Structural Engineering)
Year: II / Semester: IV

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	MSSE-241P	Final Dissertation	P	RP-3	0	0	16	10	-	-	80	120	200
2.	MSSE-242P	Comprehensive Viva	P	RP-4	0	0	0	4	-	-	40	60	100
Total					**0**	**0**	**16**	**14**	**-**	**-**	**120**	**180**	**300**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, SEC- Skill Enhancement Course, DSE- Discipline Specific Elective, Th- Theory, ESE- End Semester Examination, AECC- Ability Enhancement Compulsory Course, AC- Audit course

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Format-1

Format-1

CBCS: Statement of Credit distribution (w.e.f: Session 2024-25)

College/School: School of Engineering & Technology **Programme: M.Tech In Structural Engineering** **Duration: 4 Semester Annual/Semester: Semester**	**Credit range: 70-80** **(Suggested by** **CBCS Committee)**

Sem.	Credit	Core Course/ Foundation Course Th (8 Core)	Ability Enhancement Compulsory Course (AECC)	Skill Enhancement Course (SEC)	Discipline Specific Elective (DSE)	Generic Elective (GE)	Research Project (RP)	Internship (INT)
I	22	C-1 (4 Credit) C-2 (4 Credit) + P-1 (2 Credit) C-3 (4 Credit) C-4 (4 Credit)			DSE- 1(4 Credit)			
II	24	C-5 (4 Credit) + P-2 (2 Credit) C-6 (4 Credit) C-7 (4 Credit) C-8 (4 Credit)		SEC-1(2 Credit)	DSE- 2(4 Credit)			
III	18			SEC-2(2 Credit)	DSE- 3(4 Credit) DSE- 4(4 Credit)		Seminar (04 Credit) Synopsis of Dissertation(4 Credit)	
IV	14						Comprehensive Viva (4 Credit) Dissertation (10 Credit)	
Total Credits	**78**	8(Th)*4(Credit) = 32 02(Pr)*02(Credit) = 04 **Total = 36**		02(Pr)*2(Credit) = 04 **Total = 04**	04(Th)*4(Credit) = 16 **Total = 16**		04+04 = 08 04+ 10 = 14 **Total = 22**	

***Note: A total of 4 Credits are mandatory to earn from NPTEL/Moocs/Coursera etc during 2 years of M.Tech Program.**

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Format-2

Format-2

IIMTU-NEP Implementation: (w.e.f. Session 2024-25) (M. TECH IN STRUCTURAL ENGINEERING)

Program	Year	Semester (15) weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester	Prereq uisite	Elective (For other faculty)
M. TECH IN STRUCTURAL ENGINEERING	FIRST YEAR	SEMESTER -I	i) Core-1 (Th. 4C)	4	5	45	Analysis of reinforced Structures	5		
			ii) Core-2 (Th. 4C + P 2C)	4 2	5 3	45 30	Advanced analysis of Concrete Design Mix Design Lab	5		
			iii) Core-3 (Th. 4C)	4	5	45	Theory of Elasticity and Plasticity	5		
			iv) Core-4 (Th. 4C)	4	5	45	Research Methodology	5		
			v) DSE-1 (Th.4 C)	4	5	45	Composite material and Structure Or Computer Oriented Numerical Methods	5		
		SEMESTER - II	i) Core-5 (Th. 4C + P 2C)	4 2	5 3	45 30	Finite Element Analysis Finite Element Analysis Lab	5		
			ii) Core-6 (Th. 4C)	4	5	45	Pre-stressed Concrete Structures	5		
			iii) Core-7 (Th. 4C)	4	5	45	Dynamic analysis of structures	5		
			iv) Core-8 (Th. 4C)	4	5	45	Research and Publication Ethics	5		
			v) DSE-2 (Th. 4C)	4	5	45	Machine Learning Methods Or Optimization Techniques	5		
			vi) SEC-1 (P 2C)	2	3	30	Certification course (in advance technology on concern branch)	5		

Program	Year	Semester (15) weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester	Prerequisite	Elective (For other faculty)
M. TECH IN STRUCTURAL ENGINEERING	SECOND YEAR	SEMESTER -III	i) DSE 3 (Th. 4C)	4	5	45	Structural Stability Or Bridge Engineering	5		
			ii) DSE 4 (Th. 4C)	4	5	45	Design of Masonry Structures Or Structural Health Monitoring	5		
			iii) SEC- 2 (P 2C)	2	3	30	Certification course (in advance technology on concern branch)	5		
			iv) Lab-3 (P 4C)	4	5	45	Seminar	-		
			v) RP- 1 (P 4C)	4	5	45	Synopsis of Dissertation	-		
		SEMESTER - IV	i) RP- 2 (P 10C)	10	16	60	Dissertation	-		
			ii) RP- 3 (P 4C)	4	--	--	Comprehensive Viva	-		
Program Outcome: PO1 - PO12 [ANNEXTURE-1]							**Program Specific Outcome:** PSO1 - PSO4 [ANNEXTURE-2]			
***Major Project report will be evaluated by external & internal examiners & Research topic may be selected from the main core paper** ***A total of 4 Credits are mandatory to earn from NPTEL/Moocs/Coursera etc during 2 years of M.Tech Program.**										

ANNEXURE- I

Programme Outcome:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and Research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

ANNEXURE- II

Programme Specific Outcome:

PSO1: Attain knowledge of construction materials, construction design, -Composite material, software skill and ability to structural health monitoring and their employability skills will be enhanced

PSO2: Innovate in technology development, engineering system implementation and interact with their peers in the construction and other disciplines in industry and society.

PSO3: Independently carry out research/investigation to solve practical problems and write/ present a substantial technical report/document.

PSO4: Apply knowledge of Construction Technology in real time.

Format-3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Structural Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Analysis of Reinforced Structures**
Course Code: MSSE-111	**Title: Analysis of Reinforced Structures**

Course Objectives:
1. To understand the determinacy of structures.
2. To learn the principals of structure analyses.
3. Understand the utilization of matrix.
4. To understand the behavior of non-linear analysis of structures.
5. To evaluate the elasto-plastic analyses of frame.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Basic concepts in structure analysis**- Types of structure and their parts, loads, determinate & indeterminate structure, degree of indeterminacy.	9L
II	**Force Method:** Degree of redundancy, compatibility equation, canonical equations of force method, analysis of statically indeterminate structures - continuous beams, frames & trusses.	9L
III	**Displacement Method:** Kinematical indeterminacy, canonical equations of displacement method, comparison of the force and displacement methods, sidesway frames with absolutely rigid crossbars, settlements of supports, errors of fabrication, and analysis of symmetrical structures.	9L
IV	**Mixed Method:** Fundamental idea of the mixed method, canonical equations of the mixed method, matter of unit coefficients, influence lines method- construction of influence lines by the force method- continuous beams, hingeless nonuniform arches, construction of influence lines by the displacement method- continuous beams, redundant frames, kinematical method for construction of influence lines.	9L
V	**Matrix Stiffness Method:** Basic Ideas and Concepts, Finite Elements, Global and Local Coordinate Systems, Displacements of Joints and Degrees of Freedom, Ancillary Diagrams - Joint-Load (J -L) Diagram, Displacement-Load (Z-P) Diagram, Initial Matrices, Resolving Equations- Static Equations and Static Matrix, Geometrical Equations	9L

	and Deformation Matrix, Physical Equations and Stiffness Matrix in Local Coordinates, Stiffness Matrix in Global Coordinates.	

Reference/ Text Books:

1. Advanced Methods of Structural Analysis, Igor A. Karnovsky & Olga Lebed, springer
2. Matrix Analysis of Frames structures by William Weaver J.R and James M. Geve, CBS publications.
3. Advanced Structural Analysis by Ashok. K. Jain, New Channel Brothers.
4. Structural Analysis by C.S. Reddy.
5. Matrix Structural Analysis by Kanchi.
6. Matrix Methods of Structural Analysis by J.Meek.
7. Structural Analysis by Ghali and Neyveli.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To study the behavior statically determinant and indeterminate of beam, frame & trusses.	**L2 & L3**
CO-2	To identify the beams problems by matrix method.	**L3 &L4**
CO-3	To solve the problems of plane and space frame.	**L1& L3**
CO-4	To classify the geometrical nonlinearities.	**L2 & L3**
CO-5	To evaluate the problems of deformations.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Analysis of Reinforced Structures (MSSE-111)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Structural Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Advanced analysis of Concrete Design**
Course Code: MSSE-112	**Title: Advanced analysis of Concrete Design**

Course Objectives:
1. To understand the behaviour of continuous beams.
2. Design the bunker & silos.
3. To study the behaviour of chimney and their design.
4. To study the design of an elevated water tank.
5. To study the behaviour of portal frames and their design.

Nature of Paper: Core (Theory)

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	**T : 1**	**P : 0**	**C : 4**

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**CONTINUOUS BEAMS:** Introductions; span length; span/ depth ratio; shear force & bending moment.	**9L**
II	**BUNKER & SILOS:** Introductions; compare bunker & silos; design of rectangular bunkers; design of silos; storage in silos.	**9L**
III	**CHIMNEYS:** Introductions; parts of chimney; designing; effect of self-weight and wind load; temperature effects on developed stresses.	**9L**
IV	**ELEVATED WATER TANK:** Introductions; types; design of intz type tank; design of funnel-shaped overhead tank.	**9L**
V	**Portal frames:** Introduction and design analysis.	**9L**

Reference/ Text Books:
1. Reinforced concrete design by Kennath Leet, Tata Mc. Graw-Hill International, editions, 2nd edition, 1991.
2. Advanced Reinforced Concrete Design, N. Krishna Raju
3. IS: 456-1978
4. Bennett, E. W., Structural concrete elements, Chapman and Hall, London, 1975.
5. Reinforced concrete structures, Vol.1, by B.C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Laxmi Publications, 2004.

If the course is available as **Generic Elective**, then the students of following departments may opt it:
NO

Evaluation/Assessment Methodology	
Category	**Max. Marks**
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To study the behavior of continuous beams.	**L2 & L3**
CO-2	To understand the preparation of reinforcement scheduled.	**L3 &L4**
CO-3	To prepared the structural detailing drawing.	**L1& L3**
CO-4	To analyze the problems of strength and capacity of civil structure.	**L2 & L3**
CO-5	Design different structures as per codal provision..	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Advanced Concrete Design (MSSE-112)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Structural Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Theory of Elasticity and Plasticity**
Course Code: MSSE-113	**Title: Theory of Elasticity and Plasticity**

Course Objectives:
1. Understand the principles of analyses of stress & strain.
2. To utilise the principle of hooks law.
3. To study the concept of 2-D problems in the rectangular coordinate system.
4. To determination of displacement and bending for simple beam.
5. To know the behaviour of prismatic bar.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Elasticity- overview of continuum mechanics, definitions of stress and strain, hooks law and its limitations, derivation of plane stress and plane strain, solution of equilibrium equations, strain-displacement relations, constitutive relations, compatibility conditions, boundary conditions and their physical interpretations. Two-dimensional problems in rectangular coordinates, solution by polynomials, saint- venant's principle, determination of displacements, bending of cantilever beams. two-dimensional problems in polar coordinates, axisymmetric stress distribution analysis.	**9L**
II	Introduction of tensors; transformation laws, calculations of various tensors, kronecker's delta, e-d identity, symmetry and skew-symmetry, contraction, solutions of the comma notation, gauss' theorem, the base vectors analysis, eigenvalue problem for symmetric & quadratic tensor, equations of elasticity using index notation.	**9L**
III	Stress-strain problems in 3-d: principal stresses, principal strains, mohr's circle.	**9L**
IV	**Energy Theorems:** strain energy and complementary energy, clapeyron's theorem, virtual work and potential energy principles, the principle of complementary potential energy, betti's reciprocal theorem, principle of linear superposition, uniqueness of elasticity solution.	**9L**

V	**Torsion of prismatic bars:** Elliptic and equilateral triangular cross-section, torsion of rectangular bars.	**9L**

Reference/ Text Books:

1. Theory of Elasticity, L.S. Srinath
2. Theory of Elasticity by Timoshenko, McGraw-Hill Publications.
3. Theory of Plasticity by J. Chakarbarthy, McGraw-Hill Publications.
4. Theory of Elasticity by Y.C. Fung.
5. Theory of Elasticity by Gurucharan Singh.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To study the elasticity of different sections.	**L2 & L3**
CO-2	To identify the stress and strain for different sections.	**L3 &L4**
CO-3	To solve the problems of bending for beam.	**L1& L3**
CO-4	To analyze the torsion of prismatic bars and rectangular bars.	**L2 & L3**
CO-5	To analyse the plastic behaviour of beam.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Theory of Elasticity and Plasticity (MSSE-113)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Structural Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Research Methodology**
Course Code: MSRM-111	**Title: Research Methodology**

Course Objectives:
1. To introduce with Research Methodology and its importance.
2. To study the concept of research design.
3. To determination of data collection, analysis, and their interpretation.
4. To know the types of research reports and plagiarism.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction;** Meaning of Research; Objectives; Types; Approaches Adopted in research; Significance; Methodology; different Criteria of Research; and Challenges Faced by Researchers in India; Definition and selection of the Research Problem; Importance of literature review.	9L
II	**Research Design:** Meaning; Methods of research design; Important Concepts Relating to Research Design, Types; and Basic Principles of Designs.	9L
III	**Design of Sampling:** Introduction; Sampling techniques; Errors; Sample Survey; Types of Sampling. **Data Collection:** Types of Data, Classifications of Measurement Scales, Error in Measurement Tools, Scaling, Scaling Technics, Deciding the Scale; Collection of data; Methods of Data Collection.	9L
IV	**Testing of Hypotheses:** Basic Concepts; Hypothesis Testing; Statistics and Critical Region; Procedure for Hypothesis Testing, Limitations; Interpretation of results.	9L
V	**Interpretation and Report Writing:** Introduction; Methods of Interpretation; Precaution; Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and referencing styles, Research Journals, Indexing and citation of Journals,	9L

	Intellectual property, Plagiarism.	

Reference/ Text Books:

1. C. R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques, New Age International publishers, Third Edition.
2. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition, SAGE, 2005.
3. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition.
4. Creswell, John W. Research design: Qualitative, quantitative, and mixed methods approach. Sage publications, 2013.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Discuss the importance of the research methodology and its technique.	**L2 & L3**
CO-2	Understand the importance of literature review in research.	**L3 &L4**
CO-3	Use different methods of research design and data collections.	**L1& L3**
CO-4	Understand the several parametric tests of hypotheses.	**L2 & L3**
CO-5	To evaluate the problems and set hypotheses.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Research Methodology (MSRM-111)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Structural Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Composite material and Structures**
Course Code: MESE-111	**Composite material and Structures**

Course Objectives:
1. To understand the introduction of composite materials.
2. To know the different types of composite materials.
3. To study the behaviour of lamina and laminate.
4. To study the stress distribution in composite section.
5. To study the joints and failure modes of composite section.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Composite Material:** Definitions; history; constituents' material; fibres; matrix; fillers; lamina; laminates, properties; applications; moulding.	9L
II	**Lamina Study:** Stress-strain relation of monoclinic, orthotropic, isotropic materials; transformation of stress and strain; laminates; stress-strain relationship; laminate stiffness; coupling effects; symmetric and anti-symmetric laminates analysis; classical laminate plate theory.	9L
III	**Finite Element Analysis of Composite Structure:** Introduction; basic concepts; mass matrix; stiffness matrix, damping matrix; static and free vibration analysis; plate element formulation.	9L
IV	**Laminate Strength Analysis:** Introduction; mode of failure; stress calculation of ply failure; total and partial ply failure.	9L
V	**Composite Joint:** Introduction; types; failure modes; advantages and disadvantages.	9L

Reference/ Text Books:
1. M. Mukhopadhyay, Mechanics of Composite Materials and Structures.
2. R. M. Jones, Mechanics of Composite Materials, McGraw Hill, 1988.
3. J.N. Reddy, Mechanics of Laminated Composite Plates, CRC Press, 1999.
4. B.D. Agrawal and Broutman, Analysis of Performance of Fibre Composites, John Wiley and Sons, 1990.
5. Autar K. Kaw, Mechanics of Composite Materials, CRC Press, 2005.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To study the different types of composite material.	**L2 & L3**
CO-2	Understand to analyse the behaviour of composite section under loading.	**L3 &L4**
CO-3	To solve the problems of composite beam & plate.	**L1& L3**
CO-4	To analyse the importance of orientation and bond strength.	**L2 & L3**
CO-5	To analyse the mode of failure of composite structure.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Composite material and Structures (MESE-111)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Structural Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Computer Oriented Numerical Methods**
Course Code: MESE-112	**Title: Computer Oriented Numerical Methods**

Course Objectives:
1. Evaluate the linear equation by using different method.
2. Understand the concept of interpolation.
3. Analyze the finite difference and study their applications.
4. To examine the solution of numerical differentiation and integration problems.
5. To solve the ordinary differential equations.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Solutions of Linear Equations:** Direct method – cramer's rule, gauss – elimination method- gauss – jordan elimination – triangulation (lu decomposition) method – iterative methods jacobi – iteration method – gauss – siedel iteration, successive over-relaxation method. eigen values and eigen vectors: jacobi method for symmetric matrices.	9L
II	**Interpolation:** Linear interpolation - higher order interpolation - lagrange interpolation – interpolating polynomials using finite differences- hermite interpolation - piece-wise and spline interpolation.	9L
III	**Finite Difference and Their Applications:** Introduction- differentiation formulas by interpolating parabolas– backward and forward and central differences- derivation of differentiation formulae using taylor series- boundary conditions- beam deflection – solution of characteristic value problems- richardson's extrapolation.	9L
IV	**Numerical Differentiation:** Difference methods based on undetermined coefficients optimum choice of step length– partial differentiation. numerical integration: method based on interpolation-method based on undetermined coefficient – gauss lagrange interpolation method - radaua integration method composite integration method – double integration using trapezoidal and simpson's method.	9L
V	**Ordinary Differential Equation:** Euler's method – backward euler	9L

	method – midpoint method – single-step method, taylor's series method-boundary value problems.	

Reference/ Text Books:

1. Numerical methods for scientific and engineering computations. M. K. Jain-S. R. K. Iyengar – R. K. Jain Willey Eastern Limited.
2. Numerical methods by S. S. Shastry.
3. Applied numerical analysis by – Curtis I. Gerala- Addission Wasley – published campus.
4. Numerical methods for Engineers Stevan C. Chopra, Raymond P. Canal Mc.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To study the fundamental concept of integral transformation.	**L2 & L3**
CO-2	Understand the concept of complex variable and numerical techniques.	**L3 &L4**
CO-3	Identify and solve the problems by most suitable method.	**L1& L3**
CO-4	To use the computational tools to solve the problems.	**L2 & L3**
CO-5	To evaluate the fourier integral problem in the field of industrial engineering.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Computer Oriented Numerical Methods (MESE-112)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Structural Engineering**	**Year: I** **Semester: I**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Mix Design Lab**
Course Code: MSSE-112P	**Title: Mix Design Lab**

Course Objectives:
1. Understand the properties of cement.
2. Identify the gradation of aggregates.
3. To check the hardness and toughness of aggregate.
4. To get the high strength of concrete.
5. To provide the practical skill in civil construction.

Nature of Paper: Practical

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Perform lab test on cement.
Practical-2.	Perform lab test on aggregate.
Practical-3.	Bulking of fine Aggregate.
Practical-4.	Design the mix proportion of high strength concrete.
Practical-5.	Conduct split tensile strength.
Practical-6.	Permeability test of Concrete.
Practical-7.	Conduct slump test for workability of concrete.
Practical-8.	Air Entrainment Test on fresh concrete.

Reference/Text Books:
1. *Properties of concrete, Neville A.M., 5th Edition, Prentice Hall, 2012.*
2. *Concrete Technology, Shetty M. S., S. Chand and Co., 5th edition, 2006.*

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce (Internal)		10
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		05

5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Apply theoretical knowledge of advanced concrete design principles to practical lab experiments and real-world scenarios.	**L2 & L3**
CO-2	Conduct various tests on concrete materials, including compressive strength, tensile strength, and workability tests. Analyze and interpret the results.	**L3 &L4**
CO-3	Design advanced concrete structures considering factors like load, durability, and environmental conditions. Optimize concrete mix design for specific performance criteria.	**L1& L3**
CO-4	Gain a thorough understanding of national and international standards and codes related to concrete design and construction.	**L2 & L3**
CO-5	Understand and apply safety practices in the laboratory and in the field.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Advanced Concrete Design Lab (MSSE-112P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	1	3	1	3	3	1	0	2	0	0	2
CO-2	3	1	3	1	3	3	0	0	2	0	0	2
CO-3	3	1	3	1	3	3	0	0	2	0	0	2
CO-4	3	1	3	1	3	3	0	0	2	0	0	2
CO-5	3	1	3	1	3	3	1	0	2	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Structural Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Finite Element Analysis**
Course Code: MSSE-121	**Finite Element Analysis**

Course Objectives:
1. Understand the introduction and concept of FEM.
2. To study the principle of elasticity for strain displacement relation in matrix.
3. Analyze the stiffness matrix for 1-D & 2-D elements.
4. Evaluate the shape function of 1-D & 2-D elements.
5. Understand the different types of coordinate systems.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Concepts of fem - steps involved - merits and demerits - energy principles – discrimination - raleigh - ritz method of functional approximation.	9L
II	**Principles of Elasticity:** Stress equations - strain displacement relationships in matrix form plane stress, plane strain and axi-symmetric bodies of revolution with axisymmetric loading.	9L
III	**One Dimensional FEM:** Stiffness matrix for beam and bar elements - shape functions foe id elements.	9L
IV	**Two-Dimensional FEM:** Different types of elements for plane stress and plane strain analysis - displacement models - generalized coordinates - shape functions.	9L
V	Convergent and compatibility requirements - geometric invariance - natural coordinate system – area and volume coordinates - generation of element stiffness and nodal load matrices.	9L

Reference/ Text Books:
1. Concepts and Applications of Finite Element Analysis by Robert D.Cook, David S. Malkus and Michael E. Plesha, John Wiley & Sons.
2. Finite element Methods by OC Zienkiewicz
3. Finite element analysis, theory and programming by GS Krishna Murthy.

4. Introduction to Finite Element Method by Tirupathi Chandra Patila and Belugunudu.	
If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**	
Evaluation/Assessment Methodology	
Category	**Max. Marks**
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**
Prerequisites for the course:	

Course Learning Outcomes:		
CO-1	To study the bar and beam by FEM.	**L2 & L3**
CO-2	Understand the concept of discretization of FEM problems.	**L3 &L4**
CO-3	To solve the problems for shape function.	**L1& L3**
CO-4	Analyze the numerical problems by matrix method.	**L2 & L3**
CO-5	Evaluate the problems of plane stress and plane strain.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Finite element Analysis (MSSE-121)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Structural Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Pre-stressed Concrete Structures**
Course Code: MSSE-122	**Title: Pre-stressed Concrete Structures**

Course Objectives:
1. Understand the principle of pre-stressed member.
2. To study the different methods of pre-stressing.
3. Design the pre-stress beam member.
4. To design the flexure member sections.
5. To identify the losses in pre-stress member.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to pre-stressed concrete; materials; techniques of prestressing, prestressing systems; prestressed concrete sections for flexure; sectional properties; critical sections under working loads for pretensioned and post tensioned members; load balancing method; losses in prestress; applications.	**9L**
II	Design of cross-sections; permissible stresses in concrete and steel; design approaches using working stress method as per is 1143 – 1980; limit state of collapse – flexure and shear in beams; kern points; choice and efficiency of sections; cable profile and layouts; cable zone; deflection.	**9L**
III	End zone stresses; pretension transfer bond; transmission length; end block of post tensioned members.	**9L**
IV	Design of simply supported pre-tensioned and post tensioned slabs and beams; design of bridge girders as per irc.	**9L**
V	Analysis and design of composite prestressed concrete structures; application of prestressing to continuous beams.	**9L**

Reference/ Text Books:
1. Prestressed concrete by Krishna Raju, Tata McGraw Hill Book – Co., New Delhi.
2. Design of prestress concrete structures by T.Y. Lin and Burn, John Wiley, New York.
3. Prestressed concrete by S. Ramamrutham Dhanpat Rai & Sons, Delhi.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the utilization of pre-stressing by different method.	**L2 & L3**
CO-2	Identify the stress for flexural member.	**L3 &L4**
CO-3	To solve the problems of deflection in pre-stressed concrete beam.	**L1& L3**
CO-4	Analyze the losses in pre-stress beam.	**L2 & L3**
CO-5	Design the pre-stressed beam member.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Pre-stressed Concrete Structures (MSSE-122)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Structural Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Dynamic analysis of structures**
Course Code: MSSE-123	**Dynamic analysis of structures**

Course Objectives:
1. Understand the behavior of dynamic analysis.
2. Understand the formulation of equation of motion.
3. Analyze the behavior of vibration system.
4. Understand the concept of SDOF & MDOF system.
5. To study about the dynamic loading for vibration.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction; dynamic load and response; single-degree- of freedom system; force- displacement relationship; damping in series and parallel; damping force; degree of freedom; damped and undamped free vibrations; critical damping; logarithmic decrement; response to harmonic and periodic excitation: frequency of sdof; half power band method for damping ratio; transmissibility; frequency for periodic loading.	9L
II	Response to arbitrary, step, and different pulse loads; rectangular pulse force; half- cycle sine pulse force; duhamel integrals; numerical methods- time- stepping method; interpolation of excitation; central difference method; new mark method.	9L
III	Multi-degree freedom system, stiffness and flexibility approaches; lumped-mass matrix; free vibrations fundamental frequencies and mode shapes; Eigen value problem; Rayleigh quotient; orthogonally of modes; numerical schemes to find mode shapes and frequencies.	9L
IV	Multi degree freedom systems; response to dynamic loading; formulations of equations of motion; normal coordinates; mode superposition method; modal matrix; numerical scheme of wilson and new mark.	9L
V	Distributed systems: free vibration of uniform bars and beams, BCS in	9L

	such problems, assumed mode method, Hamilton's method, langrage method, generalized parameters.	

Reference/ Text Books:

1. Dynamics of Structures by Clough &Penzien, McGraw Hill, New York
2. Structural Dynamics by Mario Paz, C.B.S Publishers, New Delhi.
3. Dynamics of Structures by Anil K. Chopra, Pearson Education (Singapore), Delhi.
4. I.S: 1893 - 1984, "Code of practice for Earthquake resistant design of Structures" and latest I.S: 1893 - 2002 (version) Part-1.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the effect of seismic forces on structures.	**L2 & L3**
CO-2	To classify the role of vibration in structures.	**L3 &L4**
CO-3	To solve the problems of earthquake resistance structures.	**L1& L3**
CO-4	Analyze the problems of lumped mass.	**L2 & L3**
CO-5	To evaluate the dynamic loading problems.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Dynamic analysis of structures (MSSE-123)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Structural Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Research and Publication Ethics**
Course Code: PGRPE-111	**Research and Publication Ethics**

Course Objectives:

1. To understand the importance of philosophy of science and ethics.
2. To identify research misconduct and predatory publications.
3. To understand the open access publications, research metrics.
4. To understand the usage of plagiarism tools.
5. To develop effective scientific communication skills for writing research papers, proposals, and presentations.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Philosophy and Ethics:** Definition of philosophy; nature and scopes; basic concepts; different branches. Define Ethics; moral philosophy; judgements and reactions.	9L
II	**Scientific Conduct:** Ethics in science and research; Intellectual honesty and research integrity. Scientific misconducts: Falsification; Fabrication and Plagiarism; Redundant. Publications: duplicate and overlapping publications; Selective reporting and misrepresentation of data.	9L
III	**Publication Ethics:** definition; importance; standards setting initiatives and guidelines: COPE, WAME, etc.; Conflicts of interest; Publication misconduct: definition; concept; unethical behavior; types; Violation of publication ethics; authorship and contributor ship; Identification, complaints and appeals for misconduct; Predatory publisher and journals.	9L
IV	**Open Access Publishing:** Open access publications and initiatives; SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies; Software tool to identify predatory publications developed by SPPU - Journal finger / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer, Journal Suggester, etc.	9L
V	**Publication Misconduct:** Use and importance of plagiarism software like Turnitin, Urkund and other open source software tools.	9L

Reference/ Text Books:

1. Nicholas H. Steneck. Introduction to the Responsible Conduct of Research. Office of Research Integrity. 2007. Available at: https://ori.hhs.gov/sites/default/files/rcrintro.pdf.
2. The Student's Guide to Research Ethics By Paul Oliver Open University Press, 2003.
3. Responsible Conduct of Research By Adil E. Shamoo; David B. Resnik Oxford University Press, 2003.
4. Ethics in Science Education, Research and Governance Edited by Kambadur Muralidhar, Amit Ghosh Ashok Kumar Singhvi. Indian National Science Academy, 2019. ISBN : 978-81-939482-1-7.
5. Anderson B.H., Dursaton, and Poole M.: Thesis and assignment writing, Wiley Eastern 1997.
6. Bijorn Gustavii: How to write and illustrate scientific papers? Cambridge University Press.
7. Bordens K.S. and Abbott, B.b.: Research Design and Methods, Mc Graw Hill, 2008.
8. Graziano, A., M., and Raulin, M.,L.: Research Methods – A Process of Inquiry, Sixth Edition, Pearson, 2007.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To understand the fundamental concepts of philosophy and ethics in scientific research.	**L2 & L3**
CO-2	To identify and address various forms of scientific misconduct, including falsification, fabrication, and plagiarism.	**L3 &L4**
CO-3	To apply publication ethics standards and manage conflicts of interest in research and publication.	**L1& L3**
CO-4	To navigate open access publishing and utilize tools to identify predatory publications.	**L2 & L3**
CO-5	To effectively use plagiarism detection software to ensure research integrity and originality.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Research and Publication Ethics (MSRE-121)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Structural Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Machine Learning Methods**
Course Code: MESE-121	**Title: Machine Learning Methods**

Course Objectives:
1. Understand the importance of machine learning methods.
2. To equip the students analyses of structures using MLM.
3. Evaluate the performance of tall structures for strength and stability.
4. To evaluate the effect of shear wall.
5. Understand the behavior of tubular structures.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction; computational foundations; tree-based methods; decision trees; ensemble methods.	**9L**
II	Evaluation: overfitting; under fitting; uncertainty estimates; resampling; model selection; cross-validation; algorithm; statistical tests; performance metrics.	**9L**
III	Dimensionality reduction; feature selection & extraction.	**9L**
IV	Bayesian learning; text data & sentiment analysis; naive bayes classification.	**9L**
V	Regression; unsupervised learning; clustering.	**9L**

Reference/ Text Books:
1. Machine Learning: A Probabilistic Perspective, Kevin P. Murphy, The MIT Press
2. Fundamentals of Machine Learning for Predictive Data Analytics: Algorithms, Worked Examples, and Case Studies, John D. Kelleher, Brian Mac Namee, Aoife D'Arcy, The MIT Press.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA

3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understanding of the fundamental concepts and algorithms in machine learning.	**L2 & L3**
CO-2	Develop the ability to implement, train, and evaluate various machine learning algorithms using programming languages.	**L3 &L4**
CO-3	Learn to preprocess and analyze data.	**L1& L3**
CO-4	Understand different model evaluation metrics and techniques.	**L2 & L3**
CO-5	To analyse the structures using machine learning method on advanced level.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Machine Learning Methods (MESE-121)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Structural Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Optimization Techniques**
Course Code: MESE-122	**Title: Optimization Techniques**

Course Objectives:

1. Develop a comprehensive understanding of the fundamental principles and theories of optimization.
2. To determine the optimal solution of a problem.
3. Enhance problem-solving skills by applying optimization techniques to a wide range of applications.
4. Encourage research and innovation by exploring advanced topics in optimization.
5. To understand the utilization of Optimization Techniques.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction and basic concepts; types; problems.	**9L**
II	Linear programming problems; simplex methods; principle; dual simplex method; sensitivity analysis; revised simplex procedure; transportation problem; network minimization; maximal two problem; l.p. representation of networks.	**9L**
III	Queuing theory: queuing model; poison and exponential distributions; queues with combined arrivals and departures; random and series queues.	**9L**
IV	Unconstrained Optimization: Maximization and minimization of convex functions; local minima; convergence; univariate search; steepest and descent methods; metcher reeves method; conjugate gradient method.	**9L**
V	Constrained Optimization: Necessary and sufficient condition; constraints; tucker conditions; gradient projection method; penalty function methods; cutting plane methods of sibel directions.	**9L**

Reference/ Text Books:

1. Rao S.S," Optimization Theory and applications", Wiley Easter Ltd., 1979.
2. David G. Luerbeggan, "Introduction to Linear and Non-Linear Programming", Addison Wesley Publishing Co. 1973.
3. Hadley G. "Nonlinear and dynamic programming" Addison Wesley Publishing Co. 1964.
4. Cordan C.C. Beveridge and Robert S. Schedther, "Optimization Theory and Practice" McGraw Hill Co.1970.
5. Harndy A. Tahh. "operations Research, An Introduction", Macmillan Publishers Co. New York, 1982.
6. Beightfer and S. others, "Foundations of Optimization Pill", New Delhi, 1979.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Ability to formulate objective functions, constraints, and decision variables.	**L2 & L3**
CO-2	Determine the maximum and minimum value of a problem.	**L3 &L4**
CO-3	To solve complex optimization problem.	**L1& L3**
CO-4	Deep understanding of the theoretical foundations of optimization techniques.	**L2 & L3**
CO-5	To determine importance of optimization in civil engineering.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Optimization Techniques (MESE-122)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech In Structural Engineering**	**Year: I** **Semester: II**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Finite Element Analysis Lab**
Course Code: MSSE- 121P	**Title: Finite Element Analysis Lab**

Course Objectives:
1. Analyses the stress for circular plate and rectangular L bracket.
2. Analyze the stress of axi-symmetric body.
3. Analyze the mode frequency for beam.
4. Understand the behavior of harmonic analysis.
5. Analyze the thermal stresses for 2-D member.

Nature of Paper: Practical

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Stress analysis of a plate with a circular hole.
Practical-2.	Stress analysis of rectangular L bracket
Practical-3.	Stress analysis of an axi-symmetric component
Practical-4.	Stress analysis of beams (Cantilever, Simply supported, Fixed ends)
Practical-5.	Mode frequency analysis of a 2 D component
Practical-6.	Mode frequency analysis of beams (Cantilever, Simply supported, Fixed ends)
Practical-7.	Harmonic analysis of a 2D component
Practical-8.	Thermal stress analysis of a 2D component

***Note: Performe above practicals by using ANSYS**

Reference/Text Books:
1. The Finite Element Method and Applications in Engineering Using ANSYS by Erdogan Madenci and Ibrahim Guven.
2. Practical Stress Analysis with Finite Elements (3rd Edition) by Bryan J. Mac Donald.
3. Introduction to Finite Element Analysis and Design by Nam-Ho Kim and Bhavani V. Sankar.
4. Finite Element Analysis: Theory and Application with ANSYS by Saeed Moaveni.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks

1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		10
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		05
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	To study the stresses of plate member and draw the diagram.	**L2 & L3**
CO-2	Understand the utility of FEM software.	**L3 &L4**
CO-3	Classify the mode of frequency in 2D component.	**L1& L3**
CO-4	Analyze the effect of harmonic analysis.	**L2 & L3**
CO-5	Evaluate the shear stresses and thermal stress in FEM.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Finite Element Analysis Lab (MSSE- 121P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	1	3	1	3	3	1	0	2	0	0	2
CO-2	3	1	3	1	3	3	0	0	2	0	0	2
CO-3	3	1	3	1	3	3	0	0	2	0	0	2
CO-4	3	1	3	1	3	3	0	0	2	0	0	2
CO-5	3	1	3	1	3	3	1	0	2	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech in Structural Engineering**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Structural Stability**
Course Code: MESE-231	**Title: Structural Stability**

Course Objectives:
1. Understand the role of principal of stability of structures.
2. Analyze the effect of shear stress on buckling.
3. Understand the critical stress diagram and design formula for various end condition.
4. Understand the role of pure torsion for thin-walled bars.
5. Knowing the role of lateral buckling of simply supported beam and rectangular plate.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Beam columns:** differential equations for beam columns- beam columns with concentrated loads – continuous lateral loads-couples- beam columns with built in ends – continuous beams with axial load – application of trigonometrically series – effects of initial curvature on deflections – determination of allowable stresses.	9L
II	**Elastic buckling of bars and frames:** elastic buckling of straight columns – effect of shear stress on buckling – eccentrically and laterally loaded columns- buckling of frames-large deflections of buckled bars- energy methods- buckling of bars on elastic foundations- buckle line of bar with intermediate compressive forces - buckling of bars with change in cross-section – effect of shear force on critical load- built up columns.	9L
III	**In elastic buckling:** buckle line of straight bar- double modulus theory – tangent modulus theory, inelastic lateral buckling. Experiments and design formulae: experiments on columns – critical stress diagram – empirical formulae for design – various end conditions.	9L
IV	**Torsion buckling:** pure torsion of thin-walled bars of open cross section – non-uniform torsion of thin-walled bars of open cross section- torsional buckling – buckling by torsion and flexure.	9L
V	**Lateral buckling of simply supported Beams:** Beams of Rectangular cross-section subjected to pure bending. Buckling of simply supported	9L

	rectangular plates: Derivation of equation of plate subjected to constant compression in one and two directions.	

Reference/ Text Books:

1. Theory of elastic Stability by Timshenko & Gere-McGraw Hill.
2. Stability of metallic structures by Blunch- McGraw Hill.
3. Theory of Beam- Columns Vol I by Chem. & Atste Mc. Graw Hill.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Define the problems of beam column by differential equation.	**L2 & L3**
CO-2	Explain the elastic buckling of bars and frame.	**L3 &L4**
CO-3	Apply the empirical formula for various design various end condition.	**L1& L3**
CO-4	Analyze the problems for torsion buckling.	**L2 & L3**
CO-5	Evaluate the derivation of equation of plate.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Structural Stability (MESE-231)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech in Structural Engineering**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Bridge Engineering**
Course Code: MESE-232	**Title: Bridge Engineering**

Course Objectives:
1. To understand the introduction of bridge.
2. To know the different types of bridges.
3. To study the load distribution system on bridges
4. To study the design procedure of bridges.
5. To check the stability of bridges for bearing.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Concrete bridges:** introductions; type of bridge; loading conditions; seismic load; wind load; resistive force of expansion bearings; heat effect; erection forces; design of bridge.	9L
II	**Solid slab bridges**, designing	9L
III	**Girder bridges:** introductions; designing; courbon's theory; grillage analogy.	9L
IV	**Pre-stressed concrete bridges:** fundamental principles; designing; steel content; cover; spacing; types of composite sections; designing of road bridge.	9L
V	**Bridge Decks study:** Harmonic analysis and folded plate theory-Grillage analogy; design of piers and abutments.	9L

Reference/ Text Books:
1. Design of Concrete Bridges by M.G. Aswani, V.N.Vazirani and M.M. Ratwani.
2. Bridge Deck Behaviour by E.C. Hambly.
3. Concrete Bridge Design and Practice by V.K. Raina.
4. Simon A. Burtonshaw-Gunn, “Risk and Financial Management in Construction”, Gower Publishing, Ltd., 2009.
5. Warneer Z, Hirsch, Urban Economics, Macmillan, New York, 1993.
6. Eugene F. Brigham, Michael C. Ehrhardt, ”Financial Management Theory and Practice”, Cengageh Learning, 2010.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**	
Evaluation/Assessment Methodology	
Category	**Max. Marks**
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**
Prerequisites for the course:	

Course Learning Outcomes:

CO-1	To study the different types of bridges.	**L2 & L3**
CO-2	Understand to draw the reinforcement detail drawing.	**L3 &L4**
CO-3	To solve the problems of bridge for bearing.	**L1& L3**
CO-4	To analyze the calculation of bridge component parameter.	**L2 & L3**
CO-5	To select the site for bridge construction.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Bridge Engineering (MESE-232)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech in Structural Engineering**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Design of Masonry Structures**
Course Code: MESE-233	**Title: Design of Masonry Structures**

Course Objectives:
1. Develop a comprehensive understanding of the properties and behavior of masonry materials.
2. To design the masonry structures.
3. To use reinforced masonry.
4. Analysis and design of Masonry Structures.
5. Understand the concept of stress distribution.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introductions of brick, stone, and block masonry; strength; material properties; classification of mortars. defects and errors in masonry construction; cracks in masonry; reasons for cracking. strength of masonry walls: effect of unit strength, mortar strength, joint thickness, rate of absorption, effect of ageing, workmanship, strength formulae and mechanism of failure of masonry subjected to direct compression.	9L
II	Permissible compressive stresses; reduction factors; increase in permissible stresses for eccentric vertical and lateral loads; permissible tensile and shear stresses. load considerations for masonry: walls carrying axial load; eccentric load with different eccentric ratios—walls with openings and free-standing wall.	9L
III	Design considerations: effective height of walls and columns; opening in walls; effective length; effective thickness; slenderness ratio; eccentricity; load dispersion; arching action and lintels.	9L
IV	Design of load bearing masonry walls for building up to 3-storeys using is 1905 and sp20 procedure.	9L
V	Reinforced masonry and its application; flexural and compression elements of reinforced masonry; shear walls. Composite masonry walls; composite wall beam elements; in filled frames.	9L

Reference/ Text Books:

1. Henry, A.W (1990), —Structural masonry‖, Macmillan Education Ltd.
2. Dayarathnam. P (1987), —Brick and reinforced brick structures‖, Oxford & IBH Publication.
3. Sinha, B.P and Davies, S.R (1997), —Design of Masonry Structures‖, E & FN spon.
4. IS 1905-1987 (3rd revision), —Code of practice for structural use of unreinforced masonry‖, BIS, New Delhi.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Understand the concept of reinforced masonry and its applications.	**L2 & L3**
CO-2	Apply principles of structural analysis to assess and design masonry structures	**L3 &L4**
CO-3	Bring flexural and compression elements (beams and columns) of reinforced masonry shear walls.	**L1& L3**
CO-4	Understand the concept of composite wall beam elements and in filled frames.	**L2 & L3**
CO-5	Design these masonry structures.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Design of Masonry Structures (MESE-233)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech in Structural Engineering**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Structural Health Monitoring**
Course Code: MESE-234	**Title: Structural Health Monitoring**

Course Objectives:
1. To provide the detailed techniques for health monitoring of structures.
2. To know the role of health monitoring of structures.
3. To interact with new materials.
4. Gain knowledge about different types of sensors and data acquisition systems used in SHM
5. To provide practical skills to investigate the conditions of structures.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Concept of structural health monitoring; sensor systems; equipment; global and local techniques.	**9L**
II	Computational aspects of global dynamic techniques; experimental mode shapes; damage localization and quantification	**9L**
III	Piezo-electric materials and other smart materials; electro-mechanical impedance (emi) technique; low-cost adaptations.	**9L**
IV	Fatigue life assessment. integration of global and emi techniques	**9L**
V	Shear lag models	**9L**

Reference/ Text Books:
1. Ewins, D. J. (2000), Modal Testing: Theory, Practice and Applications, 2nd edition, Research Studies Press Ltd., Baldock.
2. Inman, D. J., Farrar, C.R., Steffan, V. and Lopes, V. (2005), Damage Prognosis -For Aerospace, Civil and Mechanical Systems, John Wiley & Sons, Ltd., Chichester, UK.
3. Soh, C. K, Yang Y. W. and Bhalla S. (2011), Smart Materials in Structural Health Monitoring, Control and Bio – mechanics, Springer.
4. Hixon, E.L. (1988), ―Mechanical Impedance‖, Shock and Vibration Handbook, edited by C. M. Harris, 3rd ed., Mc Graw Hill Book Co., New York, pp. 10.1-10.46.
5. Ikeda, T. (1990), Fundamentals of Piezoelectricity, Oxford.

If the course is available as **Generic Elective**, then the students of following departments may opt it:

NO		
Evaluation/Assessment Methodology		
Category		**Max. Marks**
1) Class tasks/ Sessional Examination		20
2) Presentations /Seminar		NA
3) Assignments		10
4) Research Project Report Seminar On Research Project Report		NA
5) ESE		70
Total:		**100**
Prerequisites for the course:		
Course Learning Outcomes:		
CO-1	Determine the conditions of any structures.	**L2 & L3**
CO-2	Improve the life span of the old structures.	**L3 &L4**
CO-3	Use the latest composite material in civil structure.	**L1& L3**
CO-4	Acquire knowledge and practical skills in selecting, installing, and using different types of sensors and data acquisition systems	**L2 & L3**
CO-5	Operate different instruments used in heath monitoring of structure.	**L2 & L4**
Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)		

CO-PO Mapping
Structural Health Monitoring (MESE-234)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG (R) **Class: M. Tech in Structural Engineering**	**Year: II** **Semester: III**
Credits: 4 **Theory: 0** **Practical: 4**	**Subject: Seminar**
Course Code: MSSE-231P	**Title: Seminar**

Course Objectives:

1. **Enhance Research Skills:** Develop advanced research skills necessary for identifying, analyzing, and synthesizing complex information in a chosen area of study.
2. **Improve Presentation Skills:** Cultivate the ability to effectively communicate research findings and technical information through oral presentations and written reports.
3. **Foster Critical Thinking:** Encourage critical thinking and problem-solving abilities by engaging with current trends and challenges in the field.
4. **Promote Collaboration:** Enhance collaborative skills through group discussions, peer reviews, and teamwork on research projects.
5. **Encourage Lifelong Learning:** Instill a mindset of continuous learning and professional development by exploring emerging topics and technologies.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 4 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 05	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs. =1 Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
I	Research Methods and Literature Review: Techniques for conducting literature reviews and understanding research methodologies.
II	Technical Writing: Structuring and writing research papers, including citations and references.
III	Presentation Skills: Creating and delivering effective presentations, and managing audience interactions.
IV	Current Trends: Examining recent developments and technologies in the field.
V	Research Ethics: Understanding ethical considerations, avoiding plagiarism, and maintaining academic integrity.

Reference/Text Books: NA

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal	0

2) Presentation/Seminar/Viva-Voce(Internal)	Assessment	40
3) External Practical Assessment	External Assessment	0
4) Presentation/Seminar/Viva-Voce(External)		60
5) Practical Records		0
Total:		**100**

Course Learning Outcomes:

CO-1	**Research Competence:** Students will demonstrate the ability to conduct thorough and independent research, leading to well-founded conclusions and innovative solutions.	**L2 & L3**
CO-2	**Effective Communication:** Students will exhibit strong presentation and communication skills, capable of conveying complex ideas clearly and persuasively.	**L1 & L3**
CO-3	**Analytical Proficiency:** Students will apply critical thinking and analytical skills to evaluate and interpret research findings and technical literature.	**L3 & L4**
CO-4	**Teamwork and Collaboration:** Students will effectively collaborate with peers, contributing to and benefiting from collective knowledge and diverse perspectives.	**L2 & L3**
CO-5	**Professional Growth:** Students will demonstrate an ongoing commitment to professional growth, staying informed about the latest developments in their field and applying new knowledge to their work.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Seminar (MSSE-231P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	3	3	0	2	2	0	1	2	3
CO-2	3	3	3	3	3	0	2	2	3	1	2	3
CO-3	3	3	3	3	3	2	3	2	3	2	2	3
CO-4	3	3	3	3	2	0	3	2	2	2	2	3
CO-5	3	3	3	3	0	1	3	1	2	2	2	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG (R) **Class: M. Tech in Structural Engineering**	**Year: II** **Semester: III**
Credits: 4 **Theory: 0** **Practical: 4**	**Subject: Synopsis of Dissertation**
Course Code: MSSE-232P	**Title: Synopsis of Dissertation**

Course Objectives:

1. **Research Skills:** Develop advanced research abilities, including problem identification, data collection, analysis, and drawing meaningful conclusions.
2. **Innovation:** Encourage innovative solutions to engineering challenges, contributing to the field's knowledge and advancement.
3. **Technical Communication:** Enhance written and oral communication skills for effectively sharing complex technical information.
4. **Project Management:** Develop project management skills to effectively plan, execute, and complete a research project.
5. **Contributions to Engineering:** Aim to make a significant, practical, and ethical contribution to the chosen field of engineering through the dissertation research.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 4 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 05	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs. =1 Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
I	Select a Research Topic: Choose a topic that aligns with the program's guidelines.
II	Review the Literature and Gap Identification: Conduct an extensive review of existing literature to understand the current state of knowledge in your chosen area.
III	Formulate Research Questions or Objectives: Clearly define the research questions or objectives that your dissertation will address.
IV	Research Methodology: Define the methods to achieve the research objective.
V	Collect and Analyze Data: Implement your research methodology to collect data or conduct experiments. Analyze the data using appropriate statistical or analytical techniques.

Reference/Text Books: NA

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal	10

2) Presentation/Seminar/Viva-Voce(Internal)	Assessment	50
3) External Practical Assessment	External Assessment	0
4) Presentation/Seminar/Viva-Voce(External)		90
5) Practical Records		0
Total:		**150**

Course Learning Outcomes:

CO-1	**Research Skills:** Develop the ability to design, execute, and report on a research project, including problem identification and methodology.	**L2 & L3**
CO-2	**Innovation and Critical Thinking:** Demonstrate creativity and critical thinking in addressing engineering challenges with innovative solutions.	**L1 & L3**
CO-3	**Communication Proficiency:** Exhibit clear technical writing skills and the ability to communicate research findings effectively.	**L2 & L3**
CO-4	**Project Management:** Manage research projects, including resource allocation and time management, to meet objectives and deadlines.	**L2 & L3**
CO-5	**Contribution to the Field:** Produce a dissertation that makes an original and meaningful contribution to the field of engineering.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Synopsis of Dissertation (MSSE-232P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	3	3	0	2	2	0	1	2	3
CO-2	3	3	3	3	3	0	2	2	3	1	2	3
CO-3	3	3	3	3	3	2	3	2	3	2	2	3
CO-4	3	3	3	3	2	0	3	2	2	2	2	3
CO-5	3	3	3	3	0	1	3	1	2	2	2	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: PG (R) **Class: M. Tech in Structural Engineering**	**Year: II** **Semester: IV**
Credits: 10 **Theory: 0** **Practical: 10**	**Subject: Final Dissertation**
Course Code: MSSE-241P	**Title: Final Dissertation**

Course Objectives:

1. **Research Skills:** Develop advanced research abilities, including problem identification, data collection, analysis, and drawing meaningful conclusions.
2. **Innovation:** Encourage innovative solutions to engineering challenges, contributing to the field's knowledge and advancement.
3. **Technical Communication:** Enhance written and oral communication skills for effectively sharing complex technical information.
4. **Project Management:** Develop project management skills to effectively plan, execute, and complete a research project.
5. **Contributions to Engineering:** Aim to make a significant, practical, and ethical contribution to the chosen field of engineering through the dissertation research.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 10 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 16	C : 10

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs. =1 Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
NA	Collect and Analyze Data: Implement your research methodology to collect data or conduct experiments. Analyze the data using appropriate statistical or analytical techniques.
NA	Draft the Dissertation
NA	Finalize and Submit: Make any final revisions as required by sectunity committee. Prepare the final, formatted version of dissertation.

Reference/Text Books: NA

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	30
2) Presentation/Seminar/Viva-Voce(Internal)		50
3) External Practical Assessment	External	0

4) Presentation/Seminar/Viva-Voce(External)	Assessment	120
5) Practical Records		0
Total:		**200**

Course Learning Outcomes:

CO-1	**Research Skills:** Develop the ability to design, execute, and report on a research project, including problem identification and methodology.	**L2 & L3**
CO-2	**Innovation and Critical Thinking:** Demonstrate creativity and critical thinking in addressing engineering challenges with innovative solutions.	**L1 & L3**
CO-3	**Communication Proficiency:** Exhibit clear technical writing skills and the ability to communicate research findings effectively.	**L2 & L3**
CO-4	**Project Management:** Manage research projects, including resource allocation and time management, to meet objectives and deadlines.	**L2 & L3**
CO-5	**Contribution to the Field:** Produce a dissertation that makes an original and meaningful contribution to the field of engineering.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Final Dissertation (MSSE-241P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	3	3	0	2	2	0	1	2	3
CO-2	3	3	3	3	3	0	2	2	3	1	2	3
CO-3	3	3	3	3	3	2	3	2	3	2	2	3
CO-4	3	3	3	3	2	0	3	2	2	2	2	3
CO-5	3	3	3	3	0	1	3	1	2	2	2	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: PG (R) **Class: M. Tech in Structural Engineering**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 0** **Practical: 4**	**Subject: Comprehensive Viva**
Course Code: MSSE-242P	**Title: Comprehensive Viva**

Course Objectives:

1. **Demonstrate Research Knowledge:** Assess the student's in-depth understanding of the research, including background, methods, and results.
2. **Critical Thinking and Problem-Solving:** Evaluate the ability to think critically and apply problem-solving skills to the research.
3. **Effective Communication:** Assess the student's capacity to present complex technical information clearly and engage in scholarly discussions.
4. **Ethical Considerations:** Ensure that research adheres to ethical standards and that the student can discuss ethical implications.
5. **Overall Competency:** Determine if the student has met educational objectives, displayed mastery of the field, and demonstrated readiness for the award of the M. Tech degree.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 4 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs. =1 Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
NA	Prepare Visuals: Create clear and informative figures, tables, and charts to illustrate your data and findings.
NA	Presentation and Defense: Prepare for your dissertation defense, which may involve presenting your research findings and answering questions from your committee. Address any concerns or revisions raised during the defense.

Reference/Text Books: NA

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		30
3) External Practical Assessment	External Assessment	0
4) Presentation/Seminar/Viva-Voce(External)		60

5) Practical Records		0
Total:		**100**

Course Learning Outcomes:

CO-1	**In-Depth Understanding of Research:** The student demonstrates a deep understanding of the research topic, showcasing comprehensive knowledge of the background, literature review, research methods, and results.	**L2 & L3**
CO-2	**Critical Thinking and Problem-Solving Skills:** The student exhibits strong critical thinking abilities and effectively applies problem-solving skills in addressing questions and challenges related to the research.	**L2 & L3**
CO-3	**Effective Communication:** The student effectively communicates complex technical information, presenting research findings in a clear, organized, and engaging manner during the viva.	**L1 & L3**
CO-4	**Ethical Awareness and Implications:** The student acknowledges and discusses the ethical considerations related to their research, demonstrating an understanding of ethical principles and implications.	**L2 & L3**
CO-5	**Comprehensive Competency and Scholarly Engagement:** The student's performance in the comprehensive viva demonstrates a high level of overall competency in the field of engineering, including interdisciplinary thinking (if applicable), and readiness for the award of the M. Tech degree.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

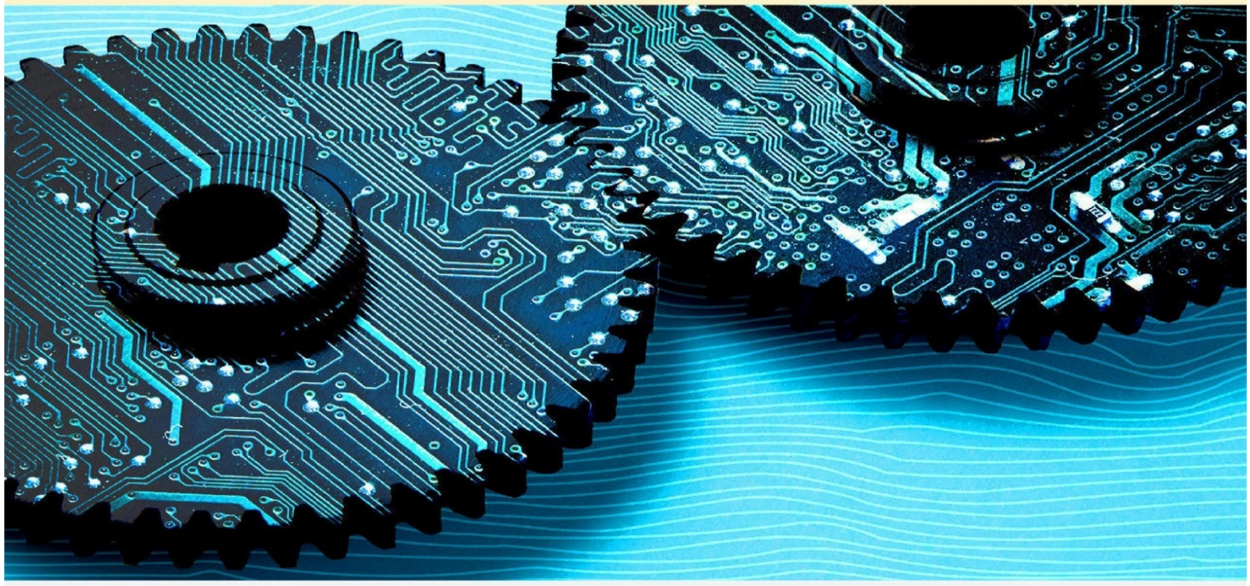
CO-PO Mapping
Comprehensive Viva (MSSE-242P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	3	3	0	2	2	0	3	0	3
CO-2	3	3	3	3	3	0	2	2	3	3	2	3
CO-3	3	3	3	3	3	2	3	2	3	3	0	3
CO-4	3	3	3	3	3	0	3	2	2	3	1	3
CO-5	3	3	3	3	3	1	3	1	2	3	2	3

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POST GRADUATE DEGREE COURSE IN
Master of Technology (Transportation Engineering)
(Academic Session 2025-26)

Evaluation Scheme

Master of Technology (Transportation Engineering)

Evaluation Scheme – Master of Technology (Transportation Engineering)
Year: I / Semester: I

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1	MSTE-111	Highway Traffic Analysis and Design	Th	Core-1	4	1	-	4	20	10	30	70	100
2	MSTE-112	Pavement Materials Characterization	Th	Core-2	4	1	-	4	20	10	30	70	100
3	MSTE-113	Advanced Traffic Engineering	Th	Core-3	4	1	-	4	20	10	30	70	100
4	MSRM-111	Research Methodology	Th	Core-4	4	1	-	4	20	10	30	70	100
5	METE-111/ METE-112	Departmental Elective Course-I	Th	DSE-1	4	1	-	4	20	10	30	70	100
6	MSTE-112P	Pavement Material Lab	P	LAB-1	0	0	2	2	10	10	20	30	50
7	NECC-111*	Industrial Visit/ Seminar/ Presentation On The Report Of Visits	P	AC	0	0	0	NC*	0	25*	25*	0	25*
8.	NECC-112*	University Social Responsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**20**	**5**	**2**	**22**	**110**	**60**	**170**	**380**	**550**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, SEC- Skill Enhancement Course, Th- Theory, ESE- End Semester Examination, AC- Audit course

*Note: (1) NECC-121 & NECC-122 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies during the semester. Student needs to qualify it but the marks will not be added in total marks
(2) A total of 4 Credits are mandatory to earn from NPTEL/Moocs/Coursera etc during 2 years of M.Tech Program.

Discipline Specific Electives -I	1. METE-111 Design of Pavement 2. METE-112 Optimization Techniques in Civil Engineering

Evaluation Scheme – Master of Technology (Transportation Engineering)
Year: I / Semester: II

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1	MSTE-121	Rural Roads Planning and Design	Th	Core-5	4	1	-	4	20	10	30	70	100
2.	MSTE-122	Strength and Deformation Analysis of Soil	Th	Core-6	4	1	-	4	20	10	30	70	100
3	MSTE-123	Environmental Impact Assessment	Th	Core-7	4	1	-	4	20	10	30	70	100
4	PGRPE-111	Research and Publication Ethics	Th	Core-8	4	1	-	4	20	10	30	70	100
5	METE-121/ METE-122	Departmental Elective Course-II	Th	DSE-2	4	1	-	4	20	10	30	70	100
6	MSTE-121P	Advanced Transportation Engineering Lab	P	LAB-2	0	0	2	2	10	10	20	30	50
7	MSEC-121	Certification course (in advance technology on concern branch)	P	SEC-1	0	0	4	2	30	20	50	-	50
7	*NECC-121	Industrial Visit/ Seminar/ Presentation On The Report Of Visits	P	AC	0	0	0	NC*	0	25*	25*	0	25*
8	*NECC-122	University Social Responsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**20**	**5**	**6**	**24**	**140**	**80**	**220**	**380**	**600**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, DSE- Discipline Specific Elective, Th- Theory, ESE- End Semester Examination, AC- Audit course

*Note: NECC-121 & NECC-122 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies during the semester. Student needs to qualify it but the marks will not be added in total marks.

Discipline Specific Electives -II	1. METE-121 Transportation System Planning and Management 2. METE-122 Bridge Engineering

Evaluation Scheme – Master of Technology (Transportation Engineering)
Year: II / Semester: III

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1	METE-231/ METE-232	Departmental Elective Course-III	Th	DSE-3	4	1	-	4	20	10	30	70	100
2	METE-233/ METE-234	Departmental Elective Course-IV	Th	DSE-4	4	1	-	4	20	10	30	70	100
3	MSTE-231P	Seminar	P	RP-1	0	0	5	4	-	-	40	60	100
4	MSTE-232P	Synopsis of Dissertation	P	RP-2	0	0	5	4	-	-	60	90	150
5	MSEC-231	Certification course (in advance technology on concern branch)	P	SEC-2	0	0	4	2	30	20	50	-	50
6	*NECC-231	Industrial Visit/ Seminar/Presentation on the report of visits	P	AC	0	0	0	NC*	0	25*	25*	0	25*
7	*NECC-232	University SocialResponsibility	P	AC	0	0	0	NC*	0	25*	25*	0	25*
Total					**8**	**2**	**14**	**18**	**70**	**40**	**210**	**290**	**500**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, DSE- Discipline Specific Elective, Th- Theory, ESE- End Semester Examination, AC- Audit course

*Note: (1) NECC-231 & NECC-232 is a Noncredit courses (Audit Courses) and will be evaluated on the basis of Industrial visits, social visits/awareness campaigns/ awareness rallies during the semester. Student needs to qualify it but the marks will not be added in total marks.
(2) A total of 4 Credits are mandatory to earn from NPTEL/Moocs/Coursera etc during 2 years of M.Tech Program.

Discipline Specific Elective-II	1. METE-231 Project Planning and Management 2. METE-232 Remote sensing and GPS for Transportation Engineering
Discipline Specific Elective-IV	1, METE-233 Intelligent Transportation Systems 2. METE-234 Geometric Design of Highway

Evaluation Scheme – Master of Technology (Transportation Engineering)
Year: II / Semester: IV

S. No.	Subject Code	Subject Name	Type	Category	Periods/Credit				Evaluation Scheme				
					L	T	P	C	CT	TA	CT+TA	ESE	Total
1.	MSTE-241P	Final Dissertation	P	RP-3	0	0	16	10			80	120	200
2.	MSTE-242P	Comprehensive Viva	P	RP-4	0	0	0	4			40	60	100
Total					**0**	**0**	**16**	**14**			**120**	**180**	**300**

L- Lecture, T- tutorials, C – Credit, P- Practical (Labs), C- Credit, CT- Class Test (Sessionals), TA- Teacher's Assessment (Assignments, Tutorials), NC- Non Credit Course, SEC- Skill Enhancement Course, DSE- Discipline Specific Elective, Th- Theory, ESE- End Semester Examination, AECC- Ability Enhancement Compulsory Course, AC- Audit course

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Format-2

IIMTU-NEP Implementation: (w.e.f. Session 2024-25) (M. TECH IN TRANSPORTATION ENGINEERING) **Format-2**

Program	Year	Semester (15) weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester	Prerequisite	Elective (For other faculty)
M. TECH IN TRANSPORTATION ENGINEERING	FIRST YEAR	SEMESTER -I	i) Core-1 (Th. 4C)	4	5	45	Highway Traffic Analysis and Design	5		
			ii) Core-2 (Th. 4C + P 2C)	4 2	5 3	45 30	Pavement Materials Characterization Pavement Material Lab	5		
			iii) Core-3 (Th. 4C)	4	5	45	Advanced Traffic Engineering	5		
			iv) Core-4 (Th. 4C)	4	5	45	Research methodology	5		
			v) DSE-1 (Th.4 C)	4	5	45	Design of Pavement Or Optimization Techniques in Civil Engineering	5		
		SEMESTER - II	i) Core-5 (Th. 4C + P 2C)	4 2	5 3	45 30	Rural Roads Planning and Design	5		
			ii) Core-6 (Th. 4C)	4	5	45	Strength and Deformation analysis of Soil	5		
			iii) Core-7 (Th. 4C)	4	5	45	Environmental Impact Analysis	5		
			iv) Core-8 (Th. 4C)	4	5	45	Research and Publication Ethics	5		
			v) DSE-2 (Th. 4C)	4	5	45	Transportation System Planning and Management Or Bridge Engineering	5		
			Vi) Lab-2 (P 2C)	2	3	30	Advanced Transportation Engineering Lab	5		
			vii) SEC-1 (P 2C)	2	3	30	Certification course (in advance technology on concern branch)	5		

Program	Year	Semester (15) weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester	Prerequisite	Elective (For other faculty)
M. TECH IN TRANSPORTATION ENGINEERING	SECOND YEAR	SEMESTER -III	i) DSE 3 (Th. 4C)	4	5	45	Project Planning and Management Or Remote sensing and GPS for Transportation Engineering	5		
			ii) DSE 4 (Th. 4C)	4	5	45	Intelligent Transportation Systems Or Geometric Design of Highway	5		
			iii) SEC- 2 (P 2C)	2	3	30	Certification course (in advance technology on concern branch)	5		
			iv) Lab-3 (P 4C)	4	5	45	Seminar	-		
			v) RP- 1 (P 4C)	4	5	45	Synopsis of Dissertation	-		
		SEMESTER - IV	i) RP- 2 (P 10C)	10	16	60	Dissertation	-		
			ii) RP- 3 (P 4C)	4	--	--	Comprehensive Viva	-		
Program Outcome: PO1 - PO12 [ANNEXTURE-1]							**Program Specific Outcome:** PSO1 - PSO4 [ANNEXTURE-2]			
***Major Project report will be evaluated by external & internal examiners & Research topic may be selected from the main core paper.** ***A total of 4 Credits are mandatory to earn from NPTEL/Moocs/Coursera etc during 2 years of M.Tech Program.**										

ANNEXURE- I

Programme Outcome:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and Research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

ANNEXURE- II

Programme Specific Outcome:

PSO1: Attain knowledge of Road construction materials, construction design, Rural Roads Planning and Design, software skill and ability to use advanced technology and their employability skills will be enhanced

PSO2: Innovate in technology development, engineering system implementation and interact with their peers in the road construction and other disciplines in industry and society.

PSO3: Independently carry out research/investigation to solve practical problems and write/ present a substantial technical report/document.

PSO4: Apply knowledge of Construction Technology and management in real time.

Format-3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Transportation Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Highway Traffic Analysis and Design**
Course Code: MSTE-111	**Title: Highway Traffic Analysis and Design**

Course Objectives:

1. Learn the relationships between the parameters of traffic flow and the types of flow theories.
2. Learn the concept of design vehicle and design volume.
3. To study the concept of roadway capacity and level of service.
4. Learn the probabilistic aspects of vehicle arrivals, gap acceptance and delays.
5. To study the concept and limitations of E-PCU, Road user facilities, Parking facilities Cycle tracks and cycle ways.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Traffic volume studies, origin destination studies, speed studies, travel time and delay studies, parking studies, accident studies.	**9L**
II	Elements of design; alignment; cross sectional elements; stopping and passing sight distance; horizontal curves; vertical curves; design problems; hill roads.	**9L**
III	Traffic regulation and control; signs and markings; traffic system management; design of grade intersections; principles of design; channelisation; design of rotaries; traffic signals; pre-timed and traffic actuated.	**9L**
IV	Design of signal setting: phase diagrams; timing diagram; signal co-ordination.	**9L**
V	Grade separated intersections; Geometric elements for divided and access controlled highways and expressways; Road furniture; Street lighting. Traffic Safety – Principles and Practices; Road Safety Audit.	**9L**

Reference/ Text Books:

1. ITE Hand Book, Highway Engineering Hand Book, McGraw - Hill.
2. AASHTO A Policy on Geometric Design of Highway and Streets
3. R. J. Salter and N. B. Hounsel, Highway Traffic Analysis and Design, Macmillan Press Ltd, 1996.

If the course is available as **Generic Elective**, then the students of following departments may opt it:

NO	
Evaluation/Assessment Methodology	
Category	**Max. Marks**
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**
Prerequisites for the course:	

Course Learning Outcomes:		
CO-1	Have knowledge about to road system, highway and traffic engineering.	**L2 & L3**
CO-2	Describe the basic components of transport system and infrastructure, their role, importance and characteristics.	**L3 &L4**
CO-3	Design and conduct traffic surveys to collect traffic data.	**L1& L3**
CO-4	Design of traffic signals.	**L2 & L3**
CO-5	Apply engineering principles to identify and investigate traffic problems and to devise and evaluate sustainable solutions.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Highway Traffic Analysis and Design (MSTE-111)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Transportation Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Pavement Materials Characterization**
Course Code: MSTE-112	**Title: Pavement Materials Characterization**

Course Objectives:
1. To identify and understand critical soil properties that influence highway construction and performance.
2. To determine and analyze index properties.
3. To explore methods of improving soil properties through physical and chemical stabilization techniques.
4. To understand different categories of grouting.
5. To study the sources, manufacturing processes, and chemical composition of bitumen.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Subgrade Soil Characterization:** Properties of subgrade layers; types of soils & mechanical response of soil; Index properties; SPT, DCPT, CPT, CBR, Plate Load test & resilient modulus; soil properties used for highway construction; Field compaction. Dynamic properties of soil: FWD test.	9L
II	**Introduction to Soil Stabilization:** Physical and Chemical modification; Stabilization with admixtures. Grouting: Categories of grouting; Art of grouting; Grouting materials; Grouting techniques and control. Introduction to Ground improvement techniques; Introduction to Geo textiles and synthetic applications.	9L
III	**Aggregate Characterization:** Origin; Classification; Types; Sampling of aggregates; properties of aggregates; Aggregate texture and skid resistance; polishing of aggregates; Proportioning and Blending of aggregates; Super pave gradation; Fuller and Thompson's Equation; 0.45 power maximum density graph; Use of locally available materials in lieu of aggregates.	9L
IV	Bitumen and Bituminous Concrete Mix Characterization: Bitumen sources and manufacturing; Chemistry of bitumen; bitumen structure; Rheology of bitumen; Elastic modulus; Dynamic modulus; visco-elastic and fatigue properties; creep test.	9L
V	Stiffness modulus of bitumen mixes using shell homographs; Resilient;	9L

	Diametral Resilient and Complex (Dynamic) Moduli of Bituminous Mixes; Permanent Deformation Parameters and other Properties.	

Reference/ Text Books:

1. Yoder and Witczak, Priniciples of Pavement Design, John Wiley and Sons.
2. Yang. H. Huang, Pavement Analysis and Design, Second Edition, Prentice Hall Inc.
3. Rajib B. Mallick and Tahar El-Korchi, Pavement Engineering – Principles and Practice, CRC Press (Taylorand Francis Group).
4. W.Ronald Hudson, Ralph Haas and Zeniswki , Modern Pavement Management, McGraw Hill and Co.
5. Relevant IRC Code.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Students will gain comprehensive knowledge of subgrade soil properties.	**L2 & L3**
CO-2	Students will understand field compaction techniques and the dynamic properties of soil.	**L3 &L4**
CO-3	Students will understand grouting categories, materials, techniques, and controls.	**L1& L3**
CO-4	Use of locally available materials as substitutes for conventional aggregates, promoting sustainable and cost-effective construction practices.	**L2 & L3**
CO-5	Able to assess the permanent deformation parameters and other critical properties of bituminous mixes.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Pavement Materials Characterization (MSTE-112)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Transportation Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Advanced Traffic Engineering**
Course Code: MSTE-113	**Title: Advanced Traffic Engineering**

Course Objectives:

1. Provide an insight on traffic and its components, factors affecting road traffic and the design of intersection.
2. Explain sampling of data, analysis and interpretation of data in conducting various surveys. Explain traffic movements, types of intersections, islands, crossings and their design.
3. Provide an insight on traffic and its components, factors affecting road traffic and the design of intersection.
4. Explain traffic movements, types of intersections, islands, crossings and their design.
5. Explain sampling of data, analysis and interpretation of data in conducting various surveys.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction to Traffic Engineering: Properties of Traffic Engineering Elements, Road Vehicle performance.	**9L**
II	Traffic Studies: Volume studies; Speed studies; Origin and destination studies and parking studies, Traffic Control devices: Various Traffic Control devices; Principles of Intersection Design; Design of signalized and un-signalized intersections; Signal Coordination.	**9L**
III	Traffic Regulations and Statistical methods Traffic Safety and Level-of-service Accidents; Lighting; Capacity and Level-of-service analysis.	**9L**
IV	Uninterrupted traffic Flow Theory: Fundamentals of Traffic flow theory; Uninterrupted Traffic flow including Macroscopic and Microscopic Traffic flow models.	**9L**
V	Interrupted traffic Flow Theory: Fundamentals of Interrupted Traffic Flow; Shockwave Analysis; Car following theory; Queuing Theory, Vehicle arrival: Gap and Gap acceptance Simulation of Traffic Systems.	**9L**

Reference/ Text Books:

1. Kadiyali, L. R., Traffic Engineering and Transport Planning, Khanna Publishers 2011.
2. O'Flaherty C A, "Transport Planning and Traffic Engineering", Butterworth Heinemann, Elsevier, Burlington, MA 2006.

3. Mannering Fred L., Kilarski Walter P. and Washburn Scott S., Principles of Traffic Engineering and Traffic Analysis, Third Edition, Wiley.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Able to acquire and apply knowledge of traffic, its components, factors affecting road traffic intersection design.	**L2 & L3**
CO-2	Able to apply the knowledge of sampling data in conducting various surveys and analysis.	**L3 &L4**
CO-3	Capable of understanding traffic movements and designing islands, intersections and road lightings.	**L1& L3**
CO-4	Capable of designing signals, redesigning the existing signals.	**L2 & L3**
CO-5	Able to remember traffic regulations, impact of noise pollution, air pollution and the method of controlling them.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Advanced Traffic Engineering (MSTE-113)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Production Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Research Methodology**
Course Code: MSRM-111	**Title: Research Methodology**

Course Objectives:
1. To introduce with Research Methodology and its importance.
2. To study the concept of research design.
3. To determination of data collection, analysis, and their interpretation.
4. To know the types of research reports and plagiarism.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction;** Meaning of Research; Objectives; Types; Approaches Adopted in research; Significance; Methodology; different Criteria of Research; and Challenges Faced by Researchers in India; Definition and selection of the Research Problem; Importance of literature review.	9L
II	**Research Design:** Meaning; Methods of research design; Important Concepts Relating to Research Design, Types; and Basic Principles of Designs.	9L
III	**Design of Sampling:** Introduction; Sampling techniques; Errors; Sample Survey; Types of Sampling. **Data Collection:** Types of Data, Classifications of Measurement Scales, Error in Measurement Tools, Scaling, Scaling Technics, Deciding the Scale; Collection of data; Methods of Data Collection.	9L
IV	**Testing of Hypotheses:** Basic Concepts; Hypothesis Testing; Statistics and Critical Region; Procedure for Hypothesis Testing, Limitations; Interpretation of results.	9L
V	**Interpretation and Report Writing:** Introduction; Methods of Interpretation; Precaution; Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and referencing styles, Research Journals, Indexing and citation of Journals, Intellectual property, Plagiarism.	9L

Reference/ Text Books:

1. C. R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques, New Age International publishers, Third Edition.
2. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition, SAGE, 2005.
3. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition.
4. Creswell, John W. Research design: Qualitative, quantitative, and mixed methods approach. Sage publications, 2013.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Discuss the importance of the research methodology and its technique.	**L2 & L3**
CO-2	Understand the importance of literature review in research.	**L3 &L4**
CO-3	Use different methods of research design and data collections.	**L1& L3**
CO-4	Understand the several parametric tests of hypotheses.	**L2 & L3**
CO-5	To evaluate the problems and set hypotheses.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Research Methodology (MSRM-111)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Transportation Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Design of Pavement**
Course Code: METE-111	**Title: Design of Pavement**

Course Objectives:

1. Identify and categorize the factors affecting design and performance of pavements.
2. Explain the basic methods and concepts used to analyses flexible and rigid pavements.
3. Explain different design methods for flexible and rigid pavement design.
4. Study design of flexible and rigid pavement using IRC, Asphalt Institute, and AASHTO methods.
5. To analyze and predict traffic loading and its impact on pavement performance.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Types and component parts of pavements, Factors affecting design and performance of pavements. Highway and airport pavements, functions of pavement components.	9L
II	**Pavement Design Factors:** Design wheel load, strength characteristics of pavement materials, climatic variations, traffic - load equivalence factors and equivalent wheel loads, aircraft loading, gear configuration and tyre pressure. Drainage – Estimation of flow, surface drainage, sub-surface drainage systems, design of sub-surface drainage structures.	9L
III	**Flexible Pavement Design:** Empirical, semi-empirical and theoretical approaches, design of highway and airport pavements by IRC, AASHTO Methods, applications of pavement design software.	9L
IV	**Rigid Pavement Design:** Types of joints and their functions, joint spacing; design of CC pavement for roads, highways and airports as per IRC, AASHTO, design of joints. Design of continuously reinforced concrete pavements. Reliability; Use of software for rigid pavement design.	9L
V	**Pavement Management:** Pavement failures, maintenance of highways, structural and functional condition evaluation of pavements, pavement management system.	9L

Reference/ Text Books:

1. Yoder and Witczak, Priniciples of Pavement Design, John Wiley and Sons
2. Yang. H. Huang, Pavement Analysis and Design, Second Edition, Prentice Hall Inc.
3. Rajib B. Mallick and Tahar El-Korchi, Pavement Engineering – Principles and Practice, CRC Press (Taylor and Francis Group)
4. W.Ronald Hudson, Ralph Haas and Zeniswki , Modern Pavement Management, McGraw Hill and Co Relevant IRC Code

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Describe the basic components of transport system and infrastructure, their role, importance and characteristics.	**L2 & L3**
CO-2	Analyze the stresses and strains in a flexible pavement using multi-layered elastic theory.	**L3 &L4**
CO-3	Analyze stresses and strains in a rigid pavement using Westergaard's theory.	**L1& L3**
CO-4	Design a flexible pavement using IRC, Asphalt Institute, and AASHTO methods.	**L2 & L3**
CO-5	Design a rigid pavement using IRC and AASHTO methods.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Design of Pavement (METE-111)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Transportation Engineering**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Optimization Techniques in Civil Engineering**
Course Code: METE-112	**Title: Optimization Techniques in Civil Engineering**

Course Objectives:

1. To understand the basic concepts and importance of optimization in civil engineering.
2. To learn the mathematical principles underlying optimization techniques, including linear algebra, calculus, and numerical methods.
3. To determine the optimal solution of a problem.
4. To study multi-objective optimization techniques for problems with multiple conflicting objectives.
5. To explore advanced optimization algorithms.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction and basic concepts; types; problems.	9L
II	Linear programming problems; simplex methods; principle; dual simplex method; sensitivity analysis; revised simplex procedure; transportation problem; network minimization; maximal two problem; L.P. representation of networks.	9L
III	**Queuing Theory:** Queuing Model; poison and exponential distributions; Queues with combined arrivals and departures; random and series queues.	9L
IV	**Unconstrained Optimization:** Maximization and minimization of convex functions, local minima, convergence, unibariate search, steepest and desent methods, metcher reeves method; conjugate gradient method.	9L
V	**Constrained Optimization:** Necessary and sufficient condition; constraints; tucker conditions; gradient projection method; penalty function methods; cutting plane methods of sibel directions.	9L

Reference/ Text Books:

1. Rao S.S, "Optimization Theory and applications", Wiley Easter Ltd., 1979.
2. David G. Luerbeggan, "Introduction to Linear and Non Linear Programming", Addison Wesley Publishing Co. 1973.

3. Hadley G. "Nonlinear and dynamic programming" Addison Wesley Publishing Co. 1964.
4. Cordan C.C. Beveridge and Robert S. Schedther, "Optimization Theory and Practice" McGraw Hill Co.1970.
5. Harndy A.Tahh. "operations Research, An Introduction", Macmillan Publishers Co. New York, 1982.
6. Beightferand S. others, "Foundations of Optimization Pill", New Delhi, 1979.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Gain a solid understanding of the fundamental concepts and importance of optimization in civil engineering.	**L2 & L3**
CO-2	Students will develop proficiency in the mathematical foundations of optimization.	**L3 &L4**
CO-3	Determine the maximum and minimum value of a problem.	**L1& L3**
CO-4	To solve complex optimization problem.	**L2 & L3**
CO-5	Students will optimize transportation systems and traffic management strategies.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Optimization Techniques in Civil Engineering (METE-112)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Program: PG(R) **Class: M.Tech in Transportation Engineering**	**Year: I** **Semester: I**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Pavement Material Lab**
Course Code: MSTE-112P	**Title: Pavement Material Lab**

Course Objectives:
1. To introduce highway material and their properties.
2. To provide skills to handle equipments.
3. Explain the properties of aggregates and different test procedure of conduction and specifications.
4. Explain CBR test to know the strength characteristics of soil.

Nature of Paper: Practical

Minimum Passing Marks/Credits: 50% Marks / 5 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Aggregate Crushing value and Impact value Test.
Practical-2.	Blending of aggregate.
Practical-3.	Striping value of aggregate Test.
Practical-4.	Bitumen content by centrifugal extractor apparatus Test.
Practical-5.	Penetration value and grade of bitumen Test.
Practical-6.	Develop bituminous mix design using Marshal.
Practical-7.	CBR test by Cone penetration / North Dakota cone Test.
Practical-8.	Measurement of axle load using portable weigh bridge.

Reference/Text Books:
1. Highway Materials testing– S.K. Khanna & C.E.G. Justo. Nem Chand & Brothers.
2. IS and IRC code, MORTH specification.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		10
3) External Practical Assessment	External Assessment	20
4) Presentation/Seminar/Viva-Voce(External)		05
5) Practical Records		05

Total:		**50**
Course Learning Outcomes:		
CO-1	To learn to operate the various apparatus used in testing of highway materials.	**L2 & L3**
CO-2	To evaluate the characteristics of aggregates.	**L3 &L4**
CO-3	Students will gain knowledge about bitumen and their specific properties.	**L1& L3**
CO-4	Students will acquire the ability to explain the California Bearing Ratio (CBR) test.	**L2 & L3**
CO-5	To interpret the test results.	**L2 & L4**
Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)		

CO-PO Mapping
Pavement Material Lab (MSTE-112P)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	1	3	1	3	3	1	0	2	0	0	2
CO-2	3	1	3	1	3	3	0	0	2	0	0	2
CO-3	3	1	3	1	3	3	0	0	2	0	0	2
CO-4	3	1	3	1	3	3	0	0	2	0	0	2
CO-5	3	1	3	1	3	3	1	0	2	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Transportation Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Rural Roads Planning and Design**
Course Code: MSTE-121	**Rural Roads Planning and Design**

Course Objectives:
1. Introduction to various factors affecting road alignment and planning.
2. Introduction of construction materials used for pavement design.
3. To provide knowledge of various methods of flexible and rigid pavements.
4. To understand the importance of community engagement and participatory planning processes.
5. To learn about maintenance practices and management strategies.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction; Importance of rural roads; classification; socio-economic impact; master plan; planning; alignment; route selection; factors controlling alignment; factors influencing alignment of hill roads; surveys; detailed project report, environmental issues.	9L
II	Geometric design: basic principles; design speed; different elements; horizontal and vertical alignment; compatibility; lateral and vertical clearances. Road materials: General; road construction material; materials for semi-rigid and rigid pavement; materials for special pavements; climatic suitability.	9L
III	Pavement Design and Specifications: Introduction, design parameters, pavement components, design of different pavement; drainage and shoulders.	9L
IV	Construction of Rural roads: General; material selection; methodology; earthwork; sub-base; base course; bituminous constructions; semi-rigid pavement construction; concrete pavements; special pavements; equipments. Use of Waste materials: Introduction; green roads; significance; fly ash; use of slags; use of rice husk; recycled aggregate; other waste materials.	9L
V	Quality control tests and maintenance: General; pre-requisite; specifications; codes of practice; quality control tests; defects; maintenance activities; inspection; classification; maintenance norms & cost.	9L

Reference/ Text Books:

1. "Highway Engineering", S.K. Khanna, C.E.G. Justo and A. Veeraraghavan, Nemchand & Brothers publications, 2014.
2. "Introduction to Transportation Planning", M.J. Bruton, UCL Press, London, UK, 1992.
3. IRC: SP 20 - 2002, "Rural roads manual".
4. IRC: SP 72 – 2007, "Guidelines for the Design of Flexible Pavements for Low Volume Rural Roads".
5. IRC: SP 62 – 2004, "Guidelines for the Design and Construction of Cement Concrete Pavements for Rural Roads".
6. IRC "Specifications for Rural Roads", Mo RD, 2004.
7. CRRI "Various reports on use of Waste Materials".

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Basic principles used in pavement design for rural roads.	**L2 & L3**
CO-2	Assimilation of mechanistic principles for the pavement design.	**L3 &L4**
CO-3	Quality control measures during construction and evaluation and maintenance measures.	**L1& L3**
CO-4	Learn to adapt rural road designs to changing conditions, such as climate change, population growth, and evolving transportation needs.	**L2 & L3**
CO-5	Students will develop project management skills specific to rural road projects, including planning, scheduling, budgeting, and resource allocation.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Rural Roads Planning and Design (MSTE-121)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Transportation Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Strength and Deformation analysis of Soil**
Course Code: MSTE-122	**Title: Strength and Deformation analysis of Soil**

Course Objectives:
1. Introduction to origin, formation, and classification of soil.
2. To provide knowledge of index properties.
3. Understand the types of soil exploration programs.
4. To provide information about shear strength of soil and its measurement.
5. To provide knowledge of elastic properties of soil.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction: Physico-Chemical aspects, Failure theories, Yield criteria, Elastic and Plastic Analysis of soil, Mohar's diagram.	9L
II	Stresses in Soil: Description of state of stress and strain at a point, stress distribution problems in elastic half pace. Boussinessqu, Westergard Mindlin and Kelvin problems. Distribution of contact pressure.Analysis of Elastic settlement. ; Soil Plasticity.	9L
III	Shear Strength of Soils: Experimental determination of shear strength, Types of Tests base on drainage condition and their practical significance, Skempton's and hankel's pore water pressure, Coefficients, Stress Path, Shear strength of unsaturated soil, Row's stress dilatancy theory.	9L
IV	Constitutive Models: Constitutive Models in Soil Mechanics: Isotropic Elastic, Anisotropic Plasticity and Viscous Models.	9L
V	Representing Soil Behavior using these Models. ; Advances in Constitutive models.	9L

Reference/ Text Books:
1. A.P.S. Selvadurai, Plasticity & Geomechanics, Cambridge University Press, 2002.
2. W.F. Chen, Limit Analysis & Soil Plasticity, Elsevier Scientific, 1975.
3. C. S. Desai and J. T. Christian, Numerical Methods in Geotechnical Engineering, McGrew Hill, New York.
4. R. F. Scott, Principles of Soil Mechanics, Addison & Wesley.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	The students obtain knowledge on compressibility parameters of soil mass.	**L2 & L3**
CO-2	The students are able to select the shear strength to design different structures for different conditions of loading, drainage and failure criteria.	**L3 &L4**
CO-3	The students can estimate the stress path in soil under drainage condition.	**L1& L3**
CO-4	The students can describe the mathematical models for solving different problems in soil mechanics.	**L2 & L3**
CO-5	Illustrate the deformation behavior of soil mass.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze**)**

CO-PO Mapping
Strength and Deformation analysis of Soil (MSTE-122)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Transportation Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Environmental Impact Analysis**
Course Code MSTE-123	**Title: Environmental Impact Analysis**

Course Objectives:

1. To understand the significance of environmental impact assessment in different engineering projects
2. To summarize the different environmental impact assessment approaches.
3. To determine the forecasting tools for evaluating the environmental impacts
4. To explain the environmental management system ideas
5. Create plans for environmental management.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction: What is EIA; Purpose; and Project types; Inputs and how do environmental impacts arise.	9L
II	Environmental impact assessment (EIA): Process-stages; Project cycle; Environmental statement and target areas fixation; Scooping; Objectives; Air pollution transport models; Noise propagation models.	9L
III	Methodologies: Including Checklists; Matrices and Networks, EIA: Case studies and Issues; Procedures for Environmental Clearance by the Government of India; Mitigation Strategies; Environmental Management; Appropriate Setting of Industries and Projects for minimizing impacts; Concept of Zoning Atlas.	9L
IV	Initial environmental examination (IEE); Environmental Impact Statement (EIS); Strategic Environmental Assessment; Rapid and Comprehensive EIA.	9L
V	Preparation of environmental management plan (EMP) procedure for obtaining environmental clearance; sitting guidelines for industries; public participation in carrying out EIA and EMP.	9L

Reference/ Text Books:

1. Environmental Impact Assessment - Larry, W. Canter McGraw-Hill.
2. Introduction to Environmental Impact Assessment - John Glasson, R. Theriveland A. Chandwic, Routledge, Taylor & Francis.

3. Methods of Environmental Impact Assessment - Peter Morris, Riki Therivel, Routledge, Taylor & Francis.
4. A Practical Guide to Environmental Impact Assessment - Paul, A Erickson, CBS Publishers & Distributors Pvt Ltd.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Determine appropriate steps to sustainable growth.	**L2 & L3**
CO-2	Recognize the environmental impact assessment procedure.	**L3 &L4**
CO-3	Inculcate the decision-making power to propose measures based on the effects on the environment.	**L1& L3**
CO-4	Determine the forecasting techniques for the evaluation of various environmental impacts.	**L2 & L3**
CO-5	Gain knowledge about the significance of environmental impact assessment in different engineering projects.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Environmental Impact Analysis (MSTE-123)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Transportation Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Research and Publication Ethics**
Course Code: PGRPE-111	**Title: Research and Publication Ethics**

Course Objectives:
1. To understand the importance of philosophy of science and ethics.
2. To identify research misconduct and predatory publications.
3. To understand the open access publications, research metrics.
4. To understand the usage of plagiarism tools.
5. To develop effective scientific communication skills for writing research papers, proposals, and presentations.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**Philosophy and Ethics:** Definition of philosophy; nature and scopes; basic concepts; different branches. Define Ethics; moral philosophy; judgements and reactions.	9L
II	**Scientific Conduct:** Ethics in science and research; Intellectual honesty and research integrity. Scientific misconducts: Falsification; Fabrication and Plagiarism; Redundant. Publications: duplicate and overlapping publications; Selective reporting and misrepresentation of data.	9L
III	**Publication Ethics:** definition; importance; standards setting initiatives and guidelines: COPE, WAME, etc.; Conflicts of interest; Publication misconduct: definition; concept; unethical behavior; types; Violation of publication ethics; authorship and contributor ship; Identification, complaints and appeals for misconduct; Predatory publisher and journals.	9L
IV	**Open Access Publishing:** Open access publications and initiatives; SHERPA/RoMEO online resource to check publisher copyright & self-archiving policies; Software tool to identify predatory publications developed by SPPU - Journal finger / journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer, Journal Suggester, etc.	9L
V	**Publication Misconduct:** Use and importance of plagiarism software like Turnitin, Urkund and other open source software tools.	9L

Reference/ Text Books:
1. Nicholas H. Steneck. Introduction to the Responsible Conduct of Research. Office of Research

Integrity. 2007. Available at: https://ori.hhs.gov/sites/default/files/rcrintro.pdf
2. The Student's Guide to Research Ethics By Paul Oliver Open University Press, 2003
3. Responsible Conduct of Research By Adil E. Shamoo; David B. Resnik Oxford University Press, 2003
4. Ethics in Science Education, Research and Governance Edited by Kambadur Muralidhar, Amit Ghosh Ashok Kumar Singhvi. Indian National Science Academy, 2019. ISBN : 978-81-939482-1-7.
5. Anderson B.H., Dursaton, and Poole M.: Thesis and assignment writing, Wiley Eastern 1997.
6. Bijorn Gustavii: How to write and illustrate scientific papers? Cambridge University Press.
7. Bordens K.S. and Abbott, B.b.: Research Design and Methods, Mc Graw Hill, 2008.
8. Graziano, A., M., and Raulin, M.,L.: Research Methods – A Process of Inquiry, Sixth Edition, Pearson, 2007.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To understand the fundamental concepts of philosophy and ethics in scientific research.	**L2 & L3**
CO-2	To identify and address various forms of scientific misconduct, including falsification, fabrication, and plagiarism.	**L3 &L4**
CO-3	To apply publication ethics standards and manage conflicts of interest in research and publication.	**L1& L3**
CO-4	To navigate open access publishing and utilize tools to identify predatory publications.	**L2 & L3**
CO-5	To effectively use plagiarism detection software to ensure research integrity and originality.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Research and Publication Ethics (MSRE-121)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Transportation Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Transportation System Planning and Management**
Course Code: METE-121	**Title: Transportation System Planning and Management**

Course Objectives:

1. Graduates of the Program will contribute to the development of transportation infrastructure that is sustainable.
2. Graduates of the program, as part of an organization or as Entrepreneurs, will continue to learn to harness evolving technologies.
3. Graduates of the program will be professional Transportation Engineers with ethical and societal responsibility.
4. Recall basic concepts and methods of urban transportation planning in the India.
5. Summarize methods of designing, conducting and administering surveys to provide the data required for transportation planning.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Importance of transportation, transportation planning methodology, hierarchical levels of planning and its relation to rural, urban areas. Long range planning, Passenger and goods transportation, General concept and process of transport planning, Land-use transport interactions, Socio-economic characteristics of Land use.	**9L**
II	Transportation Systems: Multi modal transportation system; Characteristics of Mass Transit systems including technical; Demand operational and economic problems; fixed Track Facility; Mass Rapid Transit System- Elevated; Surface and Underground construction; Express Bus System; integrated Operating Characteristics of Terminal and Transfer facilities.	**9L**
III	Urban Transportation Planning Studies Urban Travel Characteristics; Private and Public Behavior analysis; Transportation demand Surveys; Delineation of the urban area; zoning; Origin-Destination Studies; Home Interviews; trip Classification and Socio- Economic variables in trip making projections.	**9L**

IV	Planning Methodology and Systems analysis Study of existing network-trip generation techniques; Category analysis; multiple regressions techniques; Modal split analysis; Trip distribution techniques.	**9L**
V	Growth Factor model; Gravity models; Opportunity models and multiple regression models; Traffic assignment methods; Minimum Path tree-All or nothing assignment and capacity restraint techniques; analysis and evaluation techniques.	**9L**

Reference/ Text Books:

1. Khanna, S.K., Justo, C.E.G., and Veeraragavan, A., `Highway Engineering', Nem Chand and Bros, Roorkee.
2. S.C.Saxena and S.P.Arora "A text book of Railway Engineering", Dhanpat Rai publications.
3. Vukan R. Vuchic, Urban Transit Systems and Technology, Wiley and Son, New York, 2005.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Plan rural road network using different approaches.	**L2 & L3**
CO-2	Identify the cause of a pavement failure.	**L3 &L4**
CO-3	Design drainage facility for rural roads.	**L1& L3**
CO-4	Plan and schedule linear projects like highway construction.	**L2 & L3**
CO-5	Understand the fundamental concepts planning linear projects.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Transportation System Planning and Management (METE-121)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Transportation Engineering**	**Year: I** **Semester: II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Bridge Engineering**
Course Code: METE-122	**Title: Bridge Engineering**

Course Objectives:
1. To understand the introduction of bridge.
2. To know the different types of bridges.
3. To study the load distribution system on bridges
4. To study the design procedure of bridges.
5. To check the stability of bridges for bearing.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Concrete Bridges: Introductions; type of bridge; loading conditions; seismic load; wind load; resistive force of expansion bearings; heat effect; Erection Forces; design of bridge.	**9L**
II	Solid slab Bridges, designing	**9L**
III	Girder Bridges: Introductions; designing; Courbon's Theory; Grillage analogy.	**9L**
IV	Pre-Stressed Concrete Bridges: fundamental principles; designing; steel content; cover; spacing; types of Composite Sections; designing of road bridge.	**9L**
V	Bridge Decks study: Harmonic analysis and folded plate theory-Grillage analogy; design of piers and abutments.	**9L**

Reference/ Text Books:
1. Design of Concrete Bridges by M.G. Aswani, V.N. Vazirani and M.M. Ratwani.
2. Bridge Deck Behaviour by E.C. Hambly.
3. Concrete Bridge Design and Practice by V.K. Raina.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20

2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To study the different types of bridges.	**L2 & L3**
CO-2	Understand to draw the reinforcement detail drawing.	**L3 &L4**
CO-3	To solve the problems of bridge for bearing.	**L1& L3**
CO-4	To analyze the calculation of bridge component parameter.	**L2 & L3**
CO-5	To select the site for bridge construction.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Bridge Engineering (METE-122)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Program: PG(R) **Class: M.Tech in Transportation Engineering**	**Year: I** **Semester: II**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: Advanced Transportation Engineering Lab**
Course Code: MSTE-121P	**Title: Advanced Transportation Engineering Lab**

Course Objectives:
1. To measure and analyze vehicle flow at specific points over time.
2. To determine vehicle speeds at particular locations, assessing compliance with speed limits.
3. To collect data on travel patterns by identifying the starting and ending points of trips.
4. To evaluate the availability, utilization, and demand for parking spaces.
5. To conduct a thorough examination of road projects to identify potential safety issues.

Nature of Paper: Practical

Minimum Passing Marks/Credits: 50% Marks / 2 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 2	C : 2

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Practical No.	Practical Title
Practical-1.	Traffic Volume survey.
Practical-2.	Spot Speed of roadway.
Practical-3.	Origin and destination study.
Practical-4.	Parking Survey.
Practical-5.	Accident calculation.
Practical-6.	Road Safety Audit.
Practical-7.	Questionnaire Development, Evaluation and Testing.

Reference/Text Books:
1. IS and IRC Codes
2. Khanna, S. K. and Justo, C. e. G., Manual for Highway testing manuals, Nemchand Bros., Roorkee.

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		10
3) External Practical Assessment	External Assessment	20

4) Presentation/Seminar/Viva-Voce(External)		05
5) Practical Records		05
Total:		**50**

Course Learning Outcomes:

CO-1	Aware about traffic studies that are used in practice for planning and design of transportation facilities.	**L2 & L3**
CO-2	Able to use appropriate syrvey in transportation engineering.	**L3 &L4**
CO-3	Able to design parking area.	**L1& L3**
CO-4	Capable of applying the road safety technique.	**L2 & L3**
CO-5	Identification of potential safety issues and recommendations for improvements in road design and operation	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Advanced Transportation Engineering Lab (MSTE-121P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	1	3	1	3	3	1	0	2	0	0	2
CO-2	3	1	3	1	3	3	0	0	2	0	0	2
CO-3	3	1	3	1	3	3	0	0	2	0	0	2
CO-4	3	1	3	1	3	3	0	0	2	0	0	2
CO-5	3	1	3	1	3	3	1	0	2	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech in Transportation Engineering**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Project Planning and Management**
Course Code: METE-231	**Title: Project Planning and Management**

Course Objectives:
1. Formulate the development and application of models for pavement management.
2. Discuss the need of application of methods of prioritization and application of innovative methods.
3. To be aware of the organizational structure of transport corporations and their interactions.
4. To learn about depot facilities and terminals.
5. To understand economic analysis of transport projects.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Characteristics of projects; Definition and objectives of Project Management; Stages of Project Management; Project Planning Process; Establishing Project organization. Work definition: Defining work content; Time Estimation Method; Project Cost Estimation and budgeting; Project Risk Management.	9L
II	Project scheduling and Planning Tools: Work Breakdown structure; LRC; Gantt charts; CPM/PERT Networks; Developing Project Plan (Baseline); Project cash flow analysis; Project scheduling with resource Constraints: Resource Leveling and Resource Allocation.	9L
III	Specific methodologies for planning: Critical Path Method (CPM); Precedence Diagramming Method (PDM); Program Evaluation and Review Technique (PERT); Graphical Evaluation and Review Technique (GERT); Queue - Graphical Evaluation and Review Technique (GERT); Simulation Language for Alternative Modeling (SLAM); Dynamic Planning and Control Methodology (DPM); Critical Chain Planning; Resource Loading.	9L
IV	Time Cost Trade off: Crashing Heuristic; Project Implementation: Project Monitoring and Control with PERT/Cost; Contract Management; Project Procurement Management; Post Project Analysis; life-cycle and post-mortem analysis; Computers applications in Project Management; Such as Microsoft® Project; Primavera Project Planner®; Primavera® Monte Carlo; Crystal Ball® and Pro Chain® are available to the project manager	9L

	for deterministic and probabilistic planning.	
V	Primavera® P3 - for deterministic time and resource scheduling; Primavera® Monte Carlo- for probabilistic time and resource scheduling; Primavera® Expedition- for documenting multiple and complex projects; Pro Chain® - for scheduling with the critical chain method; Crystal Ball® - for risk analysis; Vensim® - for system dynamics analysis.	**9L**

Reference/ Text Books:

1. Cleland and King, VNR Project Management Handbook.
2. Wiest and Levy, Management guide to PERT/CPM, PHI.
3. Horald Kerzner, Project Management: A Systemic Approach to Planning, Scheduling and Controlling, CBS Publishers, 2002.
4. S. Choudhury, Project Scheduling and Monitoring in Practice.
5. P. K. Joy, Total Project Management: The Indian Context, Macmillan India Ltd.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Acquire knowledge statistical methods and computer application of accident analysis.	**L2 & L3**
CO-2	Analyzing the factors affecting the construction of new roads.	**L3 &L4**
CO-3	Understand the Motor Vehicle Act and statutory provision for road transport.	**L1& L3**
CO-4	Design the depots and terminals.	**L2 & L3**
CO-5	Students will be able to do scheduling of route, vehicle and crew.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Project Planning and Management (METE-231)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech in Transportation Engineering**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Remote sensing and GPS for Transportation Engineering**
Course Code: METE-232	**Title: Remote sensing and GPS for Transportation Engineering**

Course Objectives:
1. To grasp the fundamental principles and technologies of remote sensing.
2. To learn how to apply remote sensing data for various transportation engineering tasks.
3. To understand the principles of Global Positioning System.
4. To develop skills in collecting and analyzing remote sensing and GPS data.
5. To apply remote sensing and GPS technologies for monitoring transportation infrastructure.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	GIS Definition – Map and map analysis – Automated cartography – History and development of GIS – Hardware requirement – Type of data – Spatial and non- spatial data – Data structure– Vector and raster – Files and data formats – Data compression.	9L
II	Spatial analysis – Data retrieval – Query – Overlay – Vector data analysis – Raster data analysis – Modeling in GIS – Digital Elevation Model – DTM – Types of output data –Output devices – Sources of errors – Types of errors – Elimination – Accuracies - The Global Positioning system and its applications.	9L
III	Concepts and foundations of remote sensing - electromagnetic spectrum - EMR interaction with atmosphere, water vapour, ozone - Basic principles of photogrammetry – Spectral Signature and Spectral Signature curves - Remote sensing platforms and sensors.	9L
IV	Satellite system parameters, sensor parameters, earth resources and meteorological satellites, microwave sensors, Data Acquisition and interpretation - Visual Image Interpretation – Visual Image Interpretation Equipment - Digital Image Processing – Classification.	9L
V	Applications of Remote sensing and GPS in Transportation Engineering: Intelligent Transport System, Urban Transport Planning, Accident Studies, Transport System Management, Road Network Planning.	9L

Reference/ Text Books:

1. Principles of Remote Sensing, Paul Jumani, ELBS, 1985.
2. Computer processing of remotely sensed Images an Introduction – Paul M.Mather, John Wiley & Sons, 1989.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Choose the remote sensing image from different sensors, resolutions, spatial and temporal scales.	**L2 & L3**
CO-2	Explain and to comprehend large tracks of earth surface with less time and cost but more accuracy	**L3 &L4**
CO-3	Work on the various transportation software	**L1& L3**
CO-4	Understand various GIS and Remote Sensing packages	**L2 & L3**
CO-5	Develop C programs for various numerical techniques	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Remote sensing and GPS for Transportation Engineering (METE-232)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech in Transportation Engineering**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Intelligent Transportation Systems**
Course Code: METE-233	**Title: Intelligent Transportation Systems**

Course Objectives:
1. To understand the fundamental concepts of Intelligent Transportation Systems.
2. To gain familiarity with various ITS technologies.
3. To learn how ITS technologies are applied to improve traffic management.
4. To explore the design and development of ITS solutions.
5. To understand the role of ITS in improving public transportation systems.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 5	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Definition; objectives; Historical background; benefits; techniques - detectors, automatic vehicle location; automatic vehicle identification; GIS; Video data collection.	9L
II	Telecommunication in ITS: Importance of telecommunications; Information management, Traffic management Centers; Vehicle Positioning system.	9L
III	ITS functional areas: Advanced traffic management system; Advanced traveler information systems; Commercial vehicle operations; Advanced vehicle control system; Advanced Public transportation system; Advance rural transportation systems.	9L
IV	ITS user needs and services: Travel and traffic management; Public transportation management; Electronic payment; Commercial vehicle operations; Emergency management; Advanced vehicle safety systems; Information management.	9L
V	Automated highway systems: Vehicles in platoons; automated highway systems; ITS programs; Overview of ITS; ITS in developing countries.	9L

Reference/ Text Books:
1. Sussman, J.M., Perspective on ITS, Artech House Publications, 2005.
2. ITS Hand book 2000: Recommendations for world road association (PIARC) by Kan Paul Chen, John Miles.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	Students will have a solid grasp of the fundamental concepts of Intelligent Transportation Systems.	**L2 & L3**
CO-2	Familiar with various ITS technologies, such as traffic management systems, V2X communication etc.	**L3 &L4**
CO-3	Able to apply ITS technologies to enhance traffic management.	**L1& L3**
CO-4	Gain skills in designing and developing ITS solutions, including system architecture.	**L2 & L3**
CO-5	understand how ITS can improve public transportation systems, including real-time tracking, route optimization etc.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Intelligent Transportation Systems (METE-233)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	2	2	2
CO-2	3	3	2	2	1	2	0	0	0	2	2	2
CO-3	3	3	2	2	1	2	0	0	0	2	2	2
CO-4	3	3	2	2	1	2	0	0	0	2	2	2
CO-5	3	3	2	2	1	2	0	0	0	2	2	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG(R) **Class: M.Tech in Transportation Engineering**	**Year: II** **Semester: III**
Credits: 4 **Theory: 4** **Practical: 0**	**Geometric Design of Highway**
Course Code: METE-234	**Geometric Design of Highway**

Course Objectives:

1. To understand the importance of geometric design in highway engineering.
2. To understand the impact of geometric design on safety and efficiency.
3. To explore the concept of sight distance in highway design.
4. Able to recognize and use current pavement design procedures.
5. Understanding common design and construction features important to the performance of both asphalt and concrete pavements.

Nature of Paper: Theory

Minimum Passing Marks/Credits: 40% Marks / 4 Credits (30% of ESE & 40% of total)

L : 4	T : 1	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Introduction: Importance of geometric design; design controls and criteria; Highway cross Section elements: Pavement unevenness; camber; carriage way; traffic separators; kerbs; road margins; right of way.	9L
II	Sight distance: Stopping sight distance (SSD); PIEV Theory; OSD; Overtaking zones; Sight distance at intersections.	9L
III	Designs of Horizontal alignment: Design speed; horizontal curves; super elevation; radius of horizontal curves; widening of pavement on horizontal curves.	9L
IV	Horizontal transition curve: Objects of providing transition curves and its types.	9L
V	Design of vertical alignment: Gradient; vertical curves.	9L

Reference/ Text Books:

1. L.R. Kadiyalli, Traffic Engineering and Transport Planning, Khanna Publishers, 7th Edition, 2008.
2. C.A.O' Flaherty, Transport Planning and Traffic Engineering, Arnold, 1997.
3. R. P. Roess, E. S. Prassas, & W.R. Mc Shane, Traffic Engineering, Prentice Hall, 3rd Edition, 2004.
4. May, Traffic Flow Fundamentals, Prentice Hall, 1989
5. F. L. Mannering, Principles of Highway Engineering and Traffic Analysis, 4th Edition, 2008, John Wiley.

If the course is available as **Generic Elective**, then the students of following departments may opt it: **NO**

Evaluation/Assessment Methodology

Category	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	NA
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	NA
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

CO-1	To understand the geometric design of highway.	**L2 & L3**
CO-2	Ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.	**L3 &L4**
CO-3	Ability to function multi-disciplinary teams.	**L1& L3**
CO-4	Ability to identify, formulate, and solve engineering problems.	**L2 & L3**
CO-5	Understanding of ethical and professional responsibility.	**L2 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Geometric Design of Highway (METE-234)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	2	2	1	2	0	0	0	0	0	2
CO-2	3	3	2	2	1	2	0	0	0	0	0	2
CO-3	3	3	2	2	1	2	0	0	0	0	0	2
CO-4	3	3	2	2	1	2	0	0	0	0	0	2
CO-5	3	3	2	2	1	2	0	0	0	0	0	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG (R) **Class: M. Tech in Transportation Engineering**	**Year: II** **Semester: III**
Credits: 4 **Theory: 0** **Practical: 4**	**Subject: Seminar**
Course Code: MSTE-231P	**Title: Seminar**

Course Objectives:

1. **Enhance Research Skills:** Develop advanced research skills necessary for identifying, analyzing, and synthesizing complex information in a chosen area of study.
2. **Improve Presentation Skills:** Cultivate the ability to effectively communicate research findings and technical information through oral presentations and written reports.
3. **Foster Critical Thinking:** Encourage critical thinking and problem-solving abilities by engaging with current trends and challenges in the field.
4. **Promote Collaboration:** Enhance collaborative skills through group discussions, peer reviews, and teamwork on research projects.
5. **Encourage Lifelong Learning:** Instill a mindset of continuous learning and professional development by exploring emerging topics and technologies.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 4 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 05	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs. =1 Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
I	Research Methods and Literature Review: Techniques for conducting literature reviews and understanding research methodologies.
II	Technical Writing: Structuring and writing research papers, including citations and references.
III	Presentation Skills: Creating and delivering effective presentations, and managing audience interactions.
IV	Current Trends: Examining recent developments and technologies in the field.
V	Research Ethics: Understanding ethical considerations, avoiding plagiarism, and maintaining academic integrity.

Reference/Text Books: NA

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal	0

2) Presentation/Seminar/Viva-Voce(Internal)	Assessment	40
3) External Practical Assessment	External Assessment	0
4) Presentation/Seminar/Viva-Voce(External)		60
5) Practical Records		0
Total:		**100**

Course Learning Outcomes:

CO-1	**Research Competence:** Students will demonstrate the ability to conduct thorough and independent research, leading to well-founded conclusions and innovative solutions.	**L2 & L3**
CO-2	**Effective Communication:** Students will exhibit strong presentation and communication skills, capable of conveying complex ideas clearly and persuasively.	**L1 & L3**
CO-3	**Analytical Proficiency:** Students will apply critical thinking and analytical skills to evaluate and interpret research findings and technical literature.	**L3 & L4**
CO-4	**Teamwork and Collaboration:** Students will effectively collaborate with peers, contributing to and benefiting from collective knowledge and diverse perspectives.	**L2 & L3**
CO-5	**Professional Growth:** Students will demonstrate an ongoing commitment to professional growth, staying informed about the latest developments in their field and applying new knowledge to their work.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Seminar (MSTE-231P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	3	3	0	2	2	0	1	2	3
CO-2	3	3	3	3	3	0	2	2	3	1	2	3
CO-3	3	3	3	3	3	2	3	2	3	2	2	3
CO-4	3	3	3	3	2	0	3	2	2	2	2	3
CO-5	3	3	3	3	0	1	3	1	2	2	2	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: III

Program: PG (R) **Class: M. Tech in Transportation Engineering**	**Year: II** **Semester: III**
Credits: 4 **Theory: 0** **Practical: 4**	**Subject: Synopsis of Dissertation**
Course Code: MSTE-232P	**Title: Synopsis of Dissertation**

Course Objectives:

1. **Research Skills:** Develop advanced research abilities, including problem identification, data collection, analysis, and drawing meaningful conclusions.
2. **Innovation:** Encourage innovative solutions to engineering challenges, contributing to the field's knowledge and advancement.
3. **Technical Communication:** Enhance written and oral communication skills for effectively sharing complex technical information.
4. **Project Management:** Develop project management skills to effectively plan, execute, and complete a research project.
5. **Contributions to Engineering:** Aim to make a significant, practical, and ethical contribution to the chosen field of engineering through the dissertation research.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 4 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 05	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs. =1 Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
I	Select a Research Topic: Choose a topic that aligns with the program's guidelines.
II	Review the Literature and Gap Identification: Conduct an extensive review of existing literature to understand the current state of knowledge in your chosen area.
III	Formulate Research Questions or Objectives: Clearly define the research questions or objectives that your dissertation will address.
IV	Research Methodology: Define the methods to achieve the research objective.
V	Collect and Analyze Data: Implement your research methodology to collect data or conduct experiments. Analyze the data using appropriate statistical or analytical techniques.

Reference/Text Books: NA

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal	10

2) Presentation/Seminar/Viva-Voce(Internal)	Assessment	50
3) External Practical Assessment	External Assessment	0
4) Presentation/Seminar/Viva-Voce(External)		90
5) Practical Records		0
Total:		**150**

Course Learning Outcomes:

CO-1	**Research Skills:** Develop the ability to design, execute, and report on a research project, including problem identification and methodology.	**L2 & L3**
CO-2	**Innovation and Critical Thinking:** Demonstrate creativity and critical thinking in addressing engineering challenges with innovative solutions.	**L1 & L3**
CO-3	**Communication Proficiency:** Exhibit clear technical writing skills and the ability to communicate research findings effectively.	**L2 & L3**
CO-4	**Project Management:** Manage research projects, including resource allocation and time management, to meet objectives and deadlines.	**L2 & L3**
CO-5	**Contribution to the Field:** Produce a dissertation that makes an original and meaningful contribution to the field of engineering.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Synopsis of Dissertation (MSTE-232P)

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	3	3	0	2	2	0	1	2	3
CO-2	3	3	3	3	3	0	2	2	3	1	2	3
CO-3	3	3	3	3	3	2	3	2	3	2	2	3
CO-4	3	3	3	3	2	0	3	2	2	2	2	3
CO-5	3	3	3	3	0	1	3	1	2	2	2	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: PG (R) **Class: M. Tech in Transportation Engineering**	**Year: II** **Semester: IV**
Credits: 10 **Theory: 0** **Practical: 10**	**Subject: Final Dissertation**
Course Code: MSTE-241P	**Title: Final Dissertation**

Course Objectives:

1. **Research Skills:** Develop advanced research abilities, including problem identification, data collection, analysis, and drawing meaningful conclusions.
2. **Innovation:** Encourage innovative solutions to engineering challenges, contributing to the field's knowledge and advancement.
3. **Technical Communication:** Enhance written and oral communication skills for effectively sharing complex technical information.
4. **Project Management:** Develop project management skills to effectively plan, execute, and complete a research project.
5. **Contributions to Engineering:** Aim to make a significant, practical, and ethical contribution to the chosen field of engineering through the dissertation research.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 10 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 16	C : 10

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs. =1 Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
NA	**Collect and Analyze Data:** Implement your research methodology to collect data or conduct experiments. Analyze the data using appropriate statistical or analytical techniques.
NA	**Draft the Dissertation**
NA	**Finalize and Submit:** Make any final revisions as required by sect unity committee. Prepare the final, formatted version of dissertation.

Reference/Text Books: NA

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	30
2) Presentation/Seminar/Viva-Voce(Internal)		50
3) External Practical Assessment	External	0

4) Presentation/Seminar/Viva-Voce(External)	Assessment	120
5) Practical Records		0
Total:		**200**

Course Learning Outcomes:

CO-1	**Research Skills:** Develop the ability to design, execute, and report on a research project, including problem identification and methodology.	**L2 & L3**
CO-2	**Innovation and Critical Thinking:** Demonstrate creativity and critical thinking in addressing engineering challenges with innovative solutions.	**L1 & L3**
CO-3	**Communication Proficiency:** Exhibit clear technical writing skills and the ability to communicate research findings effectively.	**L2 & L3**
CO-4	**Project Management:** Manage research projects, including resource allocation and time management, to meet objectives and deadlines.	**L2 & L3**
CO-5	**Contribution to the Field:** Produce a dissertation that makes an original and meaningful contribution to the field of engineering.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze)

CO-PO Mapping
Final Dissertation (MSTE-241P)

	PO-1	**PO-2**	**PO-3**	**PO-4**	**PO-5**	**PO-6**	**PO-7**	**PO-8**	**PO-9**	**PO-10**	**PO-11**	**PO-12**
CO-1	3	3	3	3	3	0	2	2	0	1	2	3
CO-2	3	3	3	3	3	0	2	2	3	1	2	3
CO-3	3	3	3	3	3	2	3	2	3	2	2	3
CO-4	3	3	3	3	2	0	3	2	2	2	2	3
CO-5	3	3	3	3	0	1	3	1	2	2	2	3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: II / Semester: IV

Program: PG (R) **Class: M. Tech in Transportation Engineering**	**Year: II** **Semester: IV**
Credits: 4 **Theory: 0** **Practical: 4**	**Subject: Comprehensive Viva**
Course Code: MSTE-242P	**Title: Comprehensive Viva**

Course Objectives:

1. **Demonstrate Research Knowledge:** Assess the student's in-depth understanding of the research, including background, methods, and results.
2. **Critical Thinking and Problem-Solving:** Evaluate the ability to think critically and apply problem-solving skills to the research.
3. **Effective Communication:** Assess the student's capacity to present complex technical information clearly and engage in scholarly discussions.
4. **Ethical Considerations:** Ensure that research adheres to ethical standards and that the student can discuss ethical implications.
5. **Overall Competency:** Determine if the student has met educational objectives, displayed mastery of the field, and demonstrated readiness for the award of the M. Tech degree.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 4 Credits (50% of Internal Assessment & 50% of External Assessment)

L : 0	T : 0	P : 0	C : 4

Note: Theory - 1 Hr. = 1 Credit, Practical- 2 Hrs. =1 Credit (4Hrs./Week=4Credits)

Practical No.	Practical Title
NA	Prepare Visuals: Create clear and informative figures, tables, and charts to illustrate your data and findings.
NA	Presentation and Defense: Prepare for your dissertation defense, which may involve presenting your research findings and answering questions from your committee. Address any concerns or revisions raised during the defense.

Reference/Text Books: NA

Evaluation/Assessment Methodology

Category	Internal/External	Max. Marks
1) Internal Assessment	Internal Assessment	10
2) Presentation/Seminar/Viva-Voce(Internal)		30
3) External Practical Assessment	External Assessment	0
4) Presentation/Seminar/Viva-Voce(External)		60
5) Practical Records		0

Total:		**100**
Course Learning Outcomes:		
CO-1	**In-Depth Understanding of Research:** The student demonstrates a deep understanding of the research topic, showcasing comprehensive knowledge of the background, literature review, research methods, and results.	**L2 & L3**
CO-2	**Critical Thinking and Problem-Solving Skills:** The student exhibits strong critical thinking abilities and effectively applies problem-solving skills in addressing questions and challenges related to the research.	**L2 & L3**
CO-3	**Effective Communication:** The student effectively communicates complex technical information, presenting research findings in a clear, organized, and engaging manner during the viva.	**L1 & L3**
CO-4	**Ethical Awareness and Implications:** The student acknowledges and discusses the ethical considerations related to their research, demonstrating an understanding of ethical principles and implications.	**L2 & L3**
CO-5	**Comprehensive Competency and Scholarly Engagement:** The student's performance in the comprehensive viva demonstrates a high level of overall competency in the field of engineering, including interdisciplinary thinking (if applicable), and readiness for the award of the M. Tech degree.	**L3 & L4**

Note: Course (subject) Learning Outcomes (CLOs) and bloom's taxonomy (L1 : Remember, L2 : Understand, L3 : Apply, L4 : Analyze**)**

CO-PO Mapping
Comprehensive Viva (MSTE-242P)

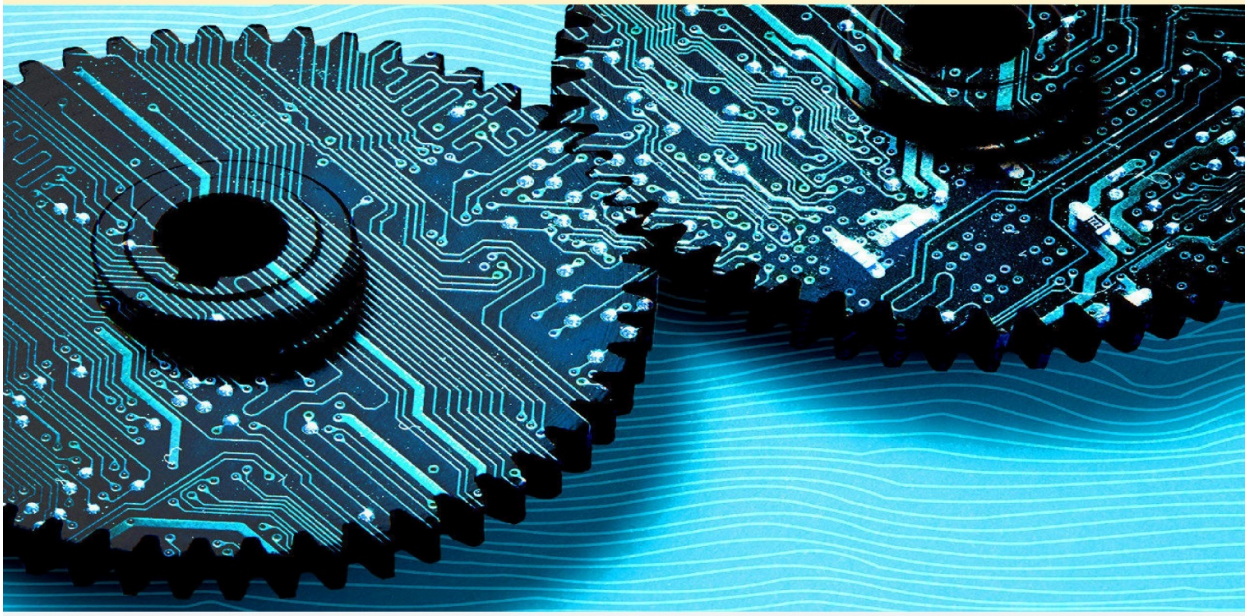
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	3	3	3	3	0	2	2	0	3	0	3
CO-2	3	3	3	3	3	0	2	2	3	3	2	3
CO-3	3	3	3	3	3	2	3	2	3	3	0	3
CO-4	3	3	3	3	3	0	3	2	2	3	1	3
CO-5	3	3	3	3	3	1	3	1	2	3	2	3

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DOCTOR OF PHILOSOPHY
Department of Mechanical Engineering
(Academic Session 2025-26)

Evaluation Scheme

Course Structure and Evaluation Scheme
DOCTOR OF PHILOSOPHY
Department of Mechanical Engineering

S.NO.	Subject Code	Subject Name	Catg.	Periods			Marks					Credits
				L	T	P	Internal			Ext	Total	
							CT	TA	Total			
1	RM ENG-101	Research Methodology	CORE	4	0	0	20	10	30	70	100	4
2	CPE-RPE101	Research & Publications Ethics	CORE	2	0	0	10	5	15	35	50	2
3	PME-111/ PME-112/ PME-113	Discipline Specific Elective Course-1 (Any one)	DSE-I	3	0	0	20	10	30	70	100	3
4	PME-114/PME-115/PME-116	Discipline Specific Elective Course-2 (Any one)	DSE-II	3	0	0	20	10	30	70	100	3
5	PME-051	Seminar	Presentation	0	0	2	0	50	50	0	50	2
TOTAL				**12**	**0**	**2**	**50**	**85**	**155**	**245**	**400**	**14**
DISCIPLINE SPECIFIC ELECTIVE COURSE -1 (ANY ONE)												
1	PME-111	Micro- Manufacturing	Elective	3	0	0	20	10	30	70	100	3
2	PME-112	Advance I C Engine	Elective	3	0	0	20	10	30	70	100	3
3	PME-113	Advanced Welding	Elective	3	0	0	20	10	30	70	100	3
DISCIPLINE SPECIFIC ELECTIVE COURSE -2 (ANY ONE)												
1	PME-114	Advanced Manufacturing Processes	Elective	3	0	0	20	10	30	70	100	3
2	PME-115	Alternative fuels for I C Engines	Elective	3	0	0	20	10	30	70	100	3
3	PME-116	Optimization Techniques	Elective	3	0	0	20	10	30	70	100	3

Format-1

Format-1

CBCS: Statement of Credit Distribution	
College/School: School of Engineering & Technology Programme: Ph.D In Mechanical Engineering Annual/Semester: Semester	Credit range: 14-16 (suggested by CBCS Committee)

	Cr	Core Course/ Foundation Course Th (6 cr) or	Ability Enhancement Compulsory Course (AECC)	Skill Enhancement Course (SEC)	Discipline Specific Elective (DSE)	Generic Elective (GE)	Research Project (RP)
I/II	14	C-1 (4 Credit) C-2 (2 Credit)		SEC-1(2 Credit)	DSE-I(3 Credit) DSE-II(3 Credit)		
Total Credits	**14**	01(Th)*4(Cr) = 04 01(Th)*2(Cr) = 02 **Total = 06**		01*2 = 02 **Total = 02**	02(Th)*3(Cr) = 06 **Total = 06**		

Format-2

Format-2

IIMTU-NEP Implementation: (Ph.D in Mechanical Engineering)

Program	Year	Semester (15 weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester	Prerequisite	Elective (For other faculty)
CERTIFICATE COURSES Ph.D in Mechanical Engineering	FIRST YEAR	SEMESTER –I/II	i) C1 (Th.4 Cr.)	4	4	40	Research Methodology	5		
			ii) C2 (Th.2 Cr.).	2	2	24	Research& Publications Ethics	6		
			iii) DSE-I (Th.3 Cr.)	3	3	30	1. PME-111- Micro-Manufacturing 2. PME-112- Advance I C Engine 3. PME-113- Advanced Welding	6		
			iv) DSE-II(Th.3 Cr.)	3	2	25	**1.** PME-114- Advanced Manufacturing Processes 2. PME-115- Alternative fuels for I C Engines 3. PME-116- Optimization Techniques	5		
			iii)SEC P 2 Cr)	2	2	20	Seminar			

Format-3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Programme: Doctor of Philosophy (R) **Class: PhD in Mechanical Engineering**	**Year: I** **Semester: I/II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Research Methodology**
Course Code: RM ENG-101	**Title: Research Methodology**

Course Objective:
To familiarize the research scholar with the fundamentals of scientific research & to gain familiarity about various data collection tools and techniques, data analysis and interpretation along with the application of computer and statistical software in research.

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 3
T: 0
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (3Hrs./Week=3 Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Definition and objectives of Research – Types of research, Various Steps in Research process, Mathematical tools for analysis, Developing a research question-Choice of a problem Literature review, Surveying, synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research – APA Ethics code.	8
II	**Quantitative Methods for problem solving:** Statistical Modeling and Analysis, Time Series Analysis Probability Distributions, Fundamentals of Statistical Analysis and Inference, Multivariate methods, Concepts of Correlation and Regression, Fundamentals of Time Series Analysis and Spectral Analysis, Error Analysis, Applications of Spectral Analysis.	8
III	**Tabular and graphical description of data:** Tables and graphs of frequency data of one variable, Tables and graphs that show the relationship between two variables, Relation between frequency distributions and other graphs, preparing data for analysis	8
IV	**Soft Computing:** Computer and its role in research, Use of statistical software SPSS, GRETL etc in research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems.	8
V	Structure and Components of Research Report, Types of Report, Layout of Research Report, Mechanism of writing a research report, referencing in academic writing.	8

TEXT BOOKS:

1. C.R. Kothari, Research Methodology Methods and Techniques, 2/e, Vishwa Prakashan, 2006
2. Donald H.Mc Burney, Research Methods, 5th Edition, Thomson Learning, ISBN:81-315-0047-0, 2006.

If the course is available as Generic Elective then the students of following departments may opt it.
NA

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Programme: Doctor of Philosophy (R) **Class: PhD in Mechanical Engineering**	**Year: I** **Semester: I/II**
Credits: 2 **Theory: 2** **Practical: 0**	**Subject: Research & Publications Ethics**
Course Code: CPE-RPE101	**Title: Research & Publications Ethics**

Course Objective:
This course has total 6 units focusing on basics of philosophy of science and ethics, research integrity, publication ethics. Hands-on-sessions are designed to identify research misconduct and predatory publications. Indexing and citation databases, open access publications, research metrics (citations, h-index, Impact Factor, etc.) and plagiarism tools will be introduced in this course.

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 2 Credits

L: 2
T: 0
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (3Hrs./Week=3 Credits)

Unit	Contents	No. of Lectures Allotted
I	• **RPE 01: PHILOSOPHY AND ETHICS (3hrs.)** 1. Introduction to philosophy: definition, nature and scope, concept, branches 2. Ethics: definition, moral philosophy, nature of moral judgments and reaction.	2
II	• **RPE 02: SCIENTIFICCONDUCT (5hrs.)** 1. Ethics with respect to science and research 2. Intellectual honesty and research integrity 3. Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP) 4. Redundant publications: duplicate and overlapping publications, salami slicing. 5. Selective reporting and misrepresentation of data.	2
III	• **RPE 03: PUBLICATION ETHICS (7hrs.)** 1. Publication ethics: definition, introduction andimportance 2. Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. 3. Conflicts of interest 4. Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types 5. Violation of publication ethics, authorship and contributor ship 6. Identification of publication misconduct, complaints and appeals	2

	7. Predatory publishers and journals	
IV	• **RPE 04: OPEN ACCESS PUBLISHING (4hrs.)** 1. Open access publications and initiatives 2. SHERPA/Ro MEO online resource to check publisher copyright & self-archiving policies 3. Software tool to identify predatory publications developed by SPPU 4. Journal finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggested, etc.	2
V	• **RPE 05: PUBLICATION MISCONDUCT (4hrs.)** **A. Group Discussions (2hrs.)** 1. Subject specific ethical issues, FFP, authorship 2. Conflicts of interest 3. Complaints and appeals: examples and fraud from India and abroad **B.** Software tools (2 hrs.) Use of plagiarism software like Tumitin, Urkund and other open source software tools	2
VI	• **RPE 06: DATABASES AND RESEARCH METRICS (7hrs.)** **A. Databases (4 hrs.)** 1. Indexing databases 2. Citation databases: Web of Science, Scopus, etc. **B. Research Metrics (3hrs.)** 1. Impact Factor of journal as per Journal Citation Report, SNIP, SIR, IPP, Cite Score 2. Metrics: h-index, g index, i10 index, altmetrics	2

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Programme: Doctor of Philosophy (R) **Class: PhD in Mechanical Engineering**	**Year: I** **Semester: I/II**
Credits: 3 **Theory: 3** **Practical: 0**	**Subject: Micro-Manufacturing**
Course Code: PME-111	**Title: Micro-Manufacturing**

Course Objective:

1. The objective of the course is to acquaint the students with the principles, basic machine tools.
2. To developments in the micro manufacturing process and research trends in the area of micro manufacturing process.
3. To understand the traditional and advanced micro-machining processes

Nature of Paper: Discipline Specific Elective

Minimum Passing Marks/Credits: 40% Marks / 3 Credits

L: 3
T: 0
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (3Hrs./Week=3 Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Introduction to the Course & Classification of Micro manufacturing Processes Challenges in Meso-, Micro-, and Nano manufacturing	5
II	**Introduction to Traditional and Advanced Micromachining Processes** • Micro turning • Micro milling • Micro grinding • Bio machining • Micro- and Nano-manufacturing by Focused Ion Beam • Electric discharge micromachining • Electrochemical micromachining • Abrasive water jet micromachining	5
III	**Nano finishing:** Magneto rheological and Allied Finishing Processes and their theoretical analysis Theoretical Analysis of Abrasive Flow Finishing (AFF) for Micro manufacturing An Integrated Wafer Surface Evolution Model for Chemical Mechanical Planarization (CMP)	5
IV	**Micro joining** • Introduction to micro joining • Laser Micro welding • Electron Beams Micro welding and Applications	5

V	**Micro forming** • Introduction to Micro forming • Micro- and Nanostructured Surface Development by Nano Plastic Forming and Roller imprint in. Micro extrusion; Micro bending with Laser	5
VI	**Micro casting and Micro molding** • Micro casting [4 lectures] • Micro molding – A soft Lithography Technique • Fabrication of Microelectronic Devices	5

TEXT BOOKS:

1. Micro manufacturing, V. K. Jain (Ed.), CRC press, 2012.
2. Micro manufacturing & Nanotechnology, N. P. Mahalik, Springer.
3. Micro facbrication & Nano manufacturing, Mark J. Jackson, CRC press.
4. Introduction to Micromachining, V. K. Jain (Ed.), Narosa publisher, 2010.

If the course is available as Generic Elective then the students of following departments may opt it.
NA

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

After completing the course, students should be able to:

1. Understanding the various aspects of mechanical, ultrasonic, abrasive, chemical and electrical micromachining.
2. Understanding the various advanced methods in micromachining and grinding.
3. Understanding the basic principles of nano polishing and its techniques.
4. Understanding the basics of micro forming and welding.
5. Understanding the various applications of micro machining.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Programme: Doctor of Philosophy (R) **Class: PhD in Mechanical Engineering**	**Year: I** **Semester: I/II**
Credits: 3 **Theory: 3** **Practical: 0**	**Subject: Advance I C Engine**
Course Code: PME-112	**Title: Advance I C Engine**

Course Objective:

1. To understand the engine operating parameters like fuel-air mixtures, temperature and cycles
2. To understand the process of supercharging, turbo charging and flow through ports and valves
3. To analyzed the combustion process in SI engine and CI engine and emissions formation during the combustion cycle and their treatment.
4. To understand the metering and flow of charge in SI engines

Nature of Paper: Discipline Specific Elective

Minimum Passing Marks/Credits: 40% Marks / 3 Credits

L: 3
T: 0
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (3Hrs./Week=3 Credits)

Unit	Contents	No. of Lectures Allotted
I	Basic characteristics of engines: Compression ratio – energy supply to an engine – power developed by engine – specific weight and specific volume – cylinder pressures – IMEP determination – torque characteristics – cylinder arrangement and their relative merits. Engine cooling systems: types of cooling – cooling of critical engine components recoiling the coolant – comparison of air cooled and liquid cooled engines.	5
II	Fuel delivery in SI engines: Classification of fuel delivery systems – fuel transfer pumps – fixed jet carburetor – computer controlled carburetor – gasoline injection systems. Ignition systems in SI engines: Battery ignition system – requirements for satisfactory operation of the ignition system – ignition timing and advancing mechanisms – magneto ignition system – electronic ignition system.	5
III	Combustion and combustion systems in CI engines: Air motion in CI engines – delay period in CI engines – types of diesel combustion systems. Scavenging and super charging in CI engines: types of scavenging systems in two stroke SI engines – improved and modified scavenging systems – super charging and engine performance – methods of super charging.	5
IV	Engine emissions, control systems and engine developments: SI engine pollutants – exhaust gas analyzer – SI engine emission control systems – particulate emissions – diesel pollution control methods – low heat rejection	5

	engines.	
V	Conventional and alternate fuels for IC engines: desirable characteristics of gasoline – desirable characteristics of diesel fuel – alternative fuels for SI engines and CI engines.	5

TEXT BOOKS:

1. Internal combustion engines fundamentals by by John B. Heywood. McGraw – Hill international editions.
2. Internal combustion engines by V. Ganesan, Tata McGraw Hill book cop. 1995
3. Internal combustion engines and air pollutions by Edward F. Obert, Intext education publishers.
4. Introduction to internal combustion engines by Richard stone 3rd edition, society of automotive engineers.

If the course is available as Generic Elective then the students of following departments may opt it.
NA

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

After completing the course, students should be able to:

1. Explain the design and operating parameters of an engine and analyze thermodynamic concepts of fuel- air cycles.
2. Summarize the concepts of volumetric efficiency, turbo charging and supercharging.
3. Explain the concepts of types of charge motion within the cylinder and flow in intake manifold.
4. Analyze different stages of combustion in SI and CI engines and explain the formation of different pollutants, their affect and their treatment

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Programme: Doctor of Philosophy (R) **Class: PhD in Mechanical Engineering**	**Year: I** **Semester: I/II**
Credits: 3 **Theory: 3** **Practical: 0**	**Subject: Advanced Welding**
Course Code: PME-113	**Title: Advanced Welding**

Course Objective:

1. Elucidate the concepts of continuity, mechanism, physics, and design elements in welding process
2. Comprehend the characteristics of weld able materials and welding technologies
3. Demonstrate the importance of modelling and simulation of welding process
4. Develop intellectual skills for correlating the micro-structural evolution with the defects and properties of weldments.

Nature of Paper: Discipline Specific Elective

Minimum Passing Marks/Credits: 40% Marks / 3 Credits

L: 3
T: 0
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (3Hrs./Week=3 Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Welding as compared with other fabrication processes, Importance and application of welding, classification of welding processes, Health & safety measures in welding. **Welding Power Sources:** Physics of welding Arc, Basic characteristics of power sources for various arc welding processes, Transformer, rectifier and generators. **Physics of Welding Arc:** Welding arc, arc initiation, voltage distribution along the arc, arc characteristics, arc efficiency, heat generation at cathode and anode, Effect of shielding gas on arc, isotherms of arcs and arc blow. **Metal Transfer:** Mechanism and types of metal transfer in various arc welding processes.	5
II	**Welding Processes:** Manual Metal Arc Welding (MMAW), TIG, MIG, Plasma Arc, Submerged Arc Welding, Electro gas and Electroslag, Flux Cored Arc Welding, Resistance welding, Friction welding, Brazing, Soldering and Braze welding processes, Laser beam welding, Electron beam welding, Ultrasonic welding, Explosive welding, Friction Stir Welding, Underwater welding & Microwave welding.	5
III	**Heat Flow Welding:** Calculation of peak temperature; Width of Heat Affected Zone (HAZ);cooling rate and solidification rates; weld thermal cycles; residual stresses and their measurement; weld distortion and its prevention.	5

IV	**Repair & Maintenance Welding:** Hard facing, Cladding, Surfacing, Metalizing processes and Reclamation welding. **Weldability:** Effects of alloying elements on weld ability, welding of plain carbon steel, Cast Iron and aluminum. Micro & Macro structures in welding.	5
V	Types of welds & joints, Joint Design, Welding Symbols, weld defects, Inspection/testing of welds, Introduction to Welding Procedure Specification & Procedure Qualification Record.	5

TEXT BOOKS:

1. Welding and Welding Technology, by- Richard L. Little, McGraw Hill Education.
2. Welding Principals and Practices, by- Edwars R. Bohnart, McGraw Hill Education.
3. Welding Engineering and Technology, by- R. S. Parmar, Khanna Publishsers.
4. Welding Technology Fundamentals by William. A. Bowditch.
5. Welding Technology by N K Srinivasan.
6. Welding Engineering and Technology by R S Parmar.
7. Modern Welding Technology by Howard B Cary and Scott Helzer.
8. Welding Handbooks (Vol. I & II).

If the course is available as Generic Elective then the students of following departments may opt it.
NA

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3)Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

After completing the course, students should be able to:

1. Explain metal transfer mechanism and classify different types of welding process on the basis of heat sources.
2. Explain the mechanism of modern welding process and their Parameters and control.
3. Explain different Non Destructive Testing methods for welds.
4. Explain different Inspection codes for weldments.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Programme: Doctor of Philosophy (R) **Class: PhD in Mechanical Engineering**	**Year: 1** **Semester: I/II**
Credits: 3 **Theory: 3** **Practical: 0**	**Subject: Advanced Manufacturing Processes**
Course Code: PME-114	**Title: Advanced Manufacturing Processes**

Course Objectives:

1. This course will enhance and optimize the production of goods through the use of innovative techniques, technologies, and methodologies.
2. Advanced manufacturing processes will enhance the ideas to reduce waste, energy consumption, and production time, while increasing productivity and throughput.

Nature of Paper: DISCIPLINE SPECIFIC ELECTIVE

Minimum Passing Marks/Credits: 40% Marks / 3 Credits

L:3
T:0
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit (3Hrs./Week=3Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Unconventional machining process – Need – Classification – Brief overview of all techniques – Merits and demerits.	**5**
II	**Mechanical Energy Based Processes:** Abrasive Jet Machining (AJM) – Water Jet Machining (WJM) – Ultrasonic Machining (USM) – Working principles – Equipment used – Process parameters – MRR – Variation in techniques used – Applications.	**5**
III	**Electrical Energy Based Process**: Electric Discharge Machining (EDM) – Working Principles – Equipments – Process parameters – MRR – Electrode / Tool – Power circuits – Tool wear – Dielectric – Flushing – Wire cut EDM – Applications.	**5**
IV	**Chemical And Electro Chemical Energy Based Process:** Chemical Machining (CHM) – Electro-Chemical Machining (ECM) – Etchants – Maskant – Techniques of applying maskants – Process parameters – MRR – Applications – Principles of ECM – Equipments – MRR – Electrical circuit – Process parameters – ECG and ECH applications.	**5**
V	**Thermal Energy Based Process:** Laser Beam Machining (LBM) – Plasma Arc Machining (PAM) – Electron Beam Machining (EBM) – Principles – Equipment – Types – Beam control techniques – Applications. **CNC Machines:** NC, CNC and DNC – Types of CNC – Constructional features – Drives and control systems – Feedback	**5**

	devices – Interchangeable tooling system – Preset and qualified tools – ISO specification – Machining center – Turning center. CNC Programming: Manual part programming – Steps involved – Sample program in lathe and milling – Computer aided part programming – APT program – CAM package – Canned cycles – Programming.	

Reference / Text Books:

1. Amitabha Ghos and Ashok Kumar Mallik, 'Manufacturing Science' Second Edition

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

After completing the course, students should be able to:

1. Demonstrate basic concepts of Advance manufacturing process.
2. Explain and differentiate the different types of congenital and non-conventional manufacturing process.
3. Able to apply the techniques to reduce waste, energy consumption, and production time,

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Programme: Doctor of Philosophy (R) **Class: PhD in Mechanical Engineering**	**Year: I** **Semester: I/II**
Credits: 3 **Theory: 3** **Practical: 0**	**Subject: Alternative fuels for I C Engines**
Course Code: PME-115	**Title: Alternative fuels for I C Engines**

Course Objectives:

1. This course will enhance skill about different types of fuels which is important for environmental, energy security, and economic considerations.
2. This course can lead to improved air quality in urban areas, reducing health risks associated with air pollution.

Nature of Paper: DISCIPLINE SPECIFIC ELECTIVE

Minimum Passing Marks/Credits: 40% Marks / 3 Credits

L:3
T:1
P:0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit (3Hrs./Week=3Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** solid fuels, gases fuels, liquid fuels, chemical structure of petroleum, petroleum refining process, important requisite qualities of engine fuels, SAE rating of fuels.	**5**
II	**FUELS:** Availability and Suitability to Piston Engines, Concept of conventional fuels, potential alternative fuels - Ethanol, Methanol, DEE/DME - Hydrogen, LPG, Natural gas, Producer gas, Bio gas and Vegetable oils - Use in I.C. Engines-Merits and Demerits of various fuels.	**5**
III	**ALCOHOL FUELS:** Properties as engine fuels - Performance in S.I. Engines - Alcohol & Gasoline blends - Flexible Fuel Vehicle - Reformed alcohols. Alcohols in C.I. Engines - Emulsions - Dual fuel systems -Spark assisted diesel engines - Surface ignition engines - Ignition accelerators - Manufacture of alcohol fuels.	**5**
IV	**GASEOUS FUELS:** Hydrogen - Properties - Use in C.I Engines - Use in S.I Engines - Storage methods - Safety precautions - Production methods. Production of Producer gas and bio gas - Raw materials - Gasification Properties Cleaning up the gas -Use in S.I. and fuel engines, LPG & Natural gas - Properties - Use in S.I. and C.I. Engines.	**5**
V	**VEGETABLE OILS:** Properties - Esterification - Performance in Engines. **FUEL QUALITY:** Fuel quality standards for Automotive Engines - Lead free gasolines, low and ultra -low sulphur diesels, LPG, CNG,	**5**

	and Biodiesels.	

Reference / Text Books:

1. Internal combustion engines by V . Ganesan, Tata McGraw Hill book cop. 2007
2. Richard L.Bechtold, Automotive Fuels Guide Book, SAE Publications, 1997.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

After completing the course, students should be able to:

1. Differentiate the different types of fuels.
2. Implement the alternative fuels in the vehicles that can lead to improved local air quality.
3. Reduce the reliance on petroleum-based fuels can help mitigate price volatility in the oil market and reduce the economic impact of oil price fluctuations

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Programme: Doctor of Philosophy (R) **Class: PhD in Mechanical Engineering**	**Year: I** **Semester: I/II**
Credits: 3 **Theory: 3** **Practical: 0**	**Subject: Optimization Techniques**
Course Code: PME-116	**Title: Optimization Techniques**

Course Objectives:

1. This course will enhance the skill to find the best possible solution to a problem from a set of feasible solutions.
2. This course can lead to improve the efficiency of processes, systems, and operations.
3. Learn about various scenarios, such as supply chain management, production planning, and transportation logistics.

Nature of Paper: DISCIPLINE SPECIFIC ELECTIVE

Minimum Passing Marks/Credits: 40% Marks / 3 Credits

L:3
T:1
P:0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit (3Hrs./Week=3Credits)

Unit	Contents	No. of Lectures Allotted
I	**Single Variable Non-Linear Unconstrained Optimization:** One dimensional Optimization methods:-Uni-modal function, elimination methods, Fibonacci method, golden section method, interpolation methods – quadratic & cubic interpolation methods.	**5**
II	**Multi variable non-linear unconstrained optimization:** Direct search method – Univariant method - pattern search methods – Powell's- Hook-Jeeves, Rosenbrock search methods- gradient methods, gradient of function, steepest decent method, Fletcher Reeves method, variable metric method.	**5**
III	**Linear Programming:** Formulation – Sensitivity analysis. Change in the constraints, cost coefficients, coefficients of the constraints, addition and deletion of variable, constraints. Simulation – Introduction – Types-steps – application – inventory – queuing – thermal system.	**5**
IV	**Integer Programming:** Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method Stochastic Programming: Basic concepts of probability theory, random variables- distributions-mean, variance, correlation, co variance, joint probability distribution- stochastic linear, dynamic programming.	**5**
V	**Geometric Programming:** Posynomials – arithmetic - geometric inequality – unconstrained G.P-constrained G.P Non Traditional	**5**

	Optimization Algorithms: Genetics Algorithm-Working Principles, Similarities and Differences between Genetic Algorithm & Traditional Methods. Simulated Annealing- Working Principle-Simple Problems.	

Reference / Text Books:

1. Optimization theory & Applications / S.S.Rao / New Age International.
2. Optimization for Engineering Design, Kalyanmoy Deb, PHI

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

After completing the course, students should be able to:

1. Explain the fundamental knowledge of Linear Programming and Dynamic Programming problems.
2. Use classical optimization techniques and numerical methods of optimization.
3. Describe the basics of different evolutionary algorithms.
4. Enumerate fundamentals of Integer programming technique and apply different techniques to solve various optimization problems arising from engineering areas.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Programme: Doctor of Philosophy (R) **Class: PhD in Mechanical Engineering**	**Year: I** **Semester: I/II**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: SEMINAR**
Course Code: PME-051	**Title: SEMINAR**
Course Objectives: To share information, research findings or expertise on a particular topic or subject matter with a targeted audience.	
Nature of Paper: Core	
Minimum Passing Marks/Credits: 50% Marks / 2 Credits	
L: 0 T: 0 P: 2 (In Hours/Week) Theory - 0 Practical- 1 Hrs.=1 Credit (3Hrs./Week=3 Credits)	

Unit	Contents	No. of Lectures Allotted
	Seminar should be presented on a very recent topic on any technological domain. It should consist of following components: Topic name, introduction, literature reviews, methodology, discussion and conclusion.	

If the course is available as Generic Elective then the students of following departments may opt it.
NA

Evaluation/Assessment Methodology

	Max. Marks
1) Internal	50
Total:	**50**

Prerequisites for the course:

Course Learning Outcomes:

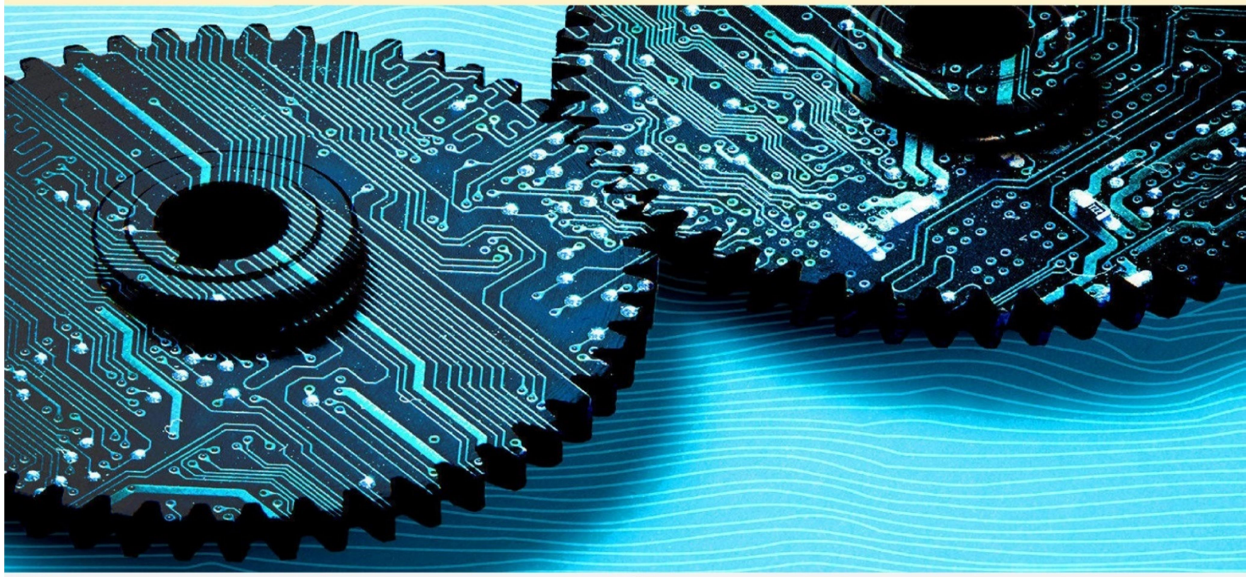
1. Able to share research findings, insights, and knowledge with faculty, and the academic community.
2. Able to demonstrating the seminar topic and showing the proficiency in the chosen area of study.
3. Improve the ability to effectively express the complex technical information to a diverse audience.

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DOCTOR OF PHILOSOPHY
DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING
(Academic Session 2025-26)

Evaluation Scheme

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Course Structure and Evaluation Scheme
DOCTOR OF PHILOSOPHY
Department of Electrical & Electronics Engineering

S. NO	Subject Code	Subject Name	Category	Periods			Marks					Credits
				L	T	P	Internal			Ext	Total	
							CT	TA	Total			
1	RM ENG-101	Research Methodology	CORE	4	0	0	20	10	30	70	100	4
2	EEE-111/ ECE-111/ ECE-112/ ECE-113/	Discipline Specific Elective Course (Any one)	DSE	3	1	0	20	10	30	70	100	4
3	CPE-RPE101	Research &PublicationEthics	CORE	2	0	0	10	5	15	35	50	2
4	ECE-011	Renewable Energy simulation software tool	CORE	2	0	0	10	5	15	35	50	2
5	ECE-051	Seminar	Presentationon	2	0	0	0	50	50	0	50	2
TOTAL				**13**	**1**	**0**	**50**	**125**	**175**	**175**	**350**	**14**
DISCIPLINE SPECIFIC ELECTIVE COURSE (ANY ONE)												
1	EEE-111	Advanced RenewableEnergy Engineering	Elective	3	1	0	20	10	30	70	100	4
2	ECE -111	Antenna Theory & Design	Elective	3	1	0	20	10	30	70	100	4
3	ECE -112	Advance EMFT	Elective	3	1	0	20	10	30	70	100	4
4	ECE -113	Microwave Engineering	Elective	3	1	0	20	10	30	70	100	4

Format-1

Format-1

CBCS: Statement of Credit distribution	
College/School: School of Engineering & Technology **Programme: Ph.D in Electrical & Electronics Engineering** **Annual/Semester: Semester**	**Credit range: 14-16 (suggested by CBCS Committee)**

Sem.	Cr	Core Course/ Foundation Course Th (6 cr) or	Ability Enhancement Compulsory Course (AECC)	Skill Enhancement Course (SEC)	Discipline Specific Elective (DSE)	Generic Elective (GE)	Research Project (RP)
I/II	14	C-1 (4 Credit) C-2 (2 Credit) C-3 (3 Credit)		SEC-1(2 Credit)	DSE-I(4 Credit)		
Total Credits	**14**	01(Th)*4(Cr) = 04 02(Th)*2(Cr) = 04 **Total = 08**		01*2 = 02 **Total = 02**	01(Th)*4(Cr) = 04 **Total = 04**		

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Format-2

Format-2

IIMTU-NEP Implementation: (Ph.D in Electrical & Electronics Engineering)

Program	Year	Semester (15 Weeks)	Paper	Credit	Periods per Week	Periods (Hours) per Semester	Paper Title	Unit (Periods per semester	Prerequisite	Elective (For other faculty)
CERTIFICATE COURSES Ph.D in Electrical & Electronics Engineering	FIRST YEAR	SEMESTER –I/II	i) C1 (Th.4 Cr.)	4	4	40	Research Methodology	5		
			ii) C2 (Th.2 Cr.).	2	2	24	Research& Publications Ethics	6		
			iii) C3 (Th.2 Cr.).	2	2	24	Renewable Energy simulation software tool	4		
			iv) DSE-I(Th.4 Cr.)	4	4	40	1. EEE-111- Advanced Renewable Energy Engineering 2. ECE-111 Antenna Theory &Design 3. ECE-112 Advance EMFT 4. ECE-113 Microwave Engineering	5		
			iii) SEC P 2 Cr)	2	2	20	Seminar			

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Format-3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Programme: Doctor of Philosophy (R) **Class: PhD in Electrical & Electronics Engineering**	**Year: I** **Semester: I/II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Research Methodology**
Course Code: RM ENG-101	**Title: Research Methodology**

Course Objective:
1. To familiarize the research scholar with the fundamentals of scientific research.
2. To gain familiarity about various data collection tools and techniques, data analysis and interpretation along with the application of computer and statistical software in research.

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4
T: 0
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (3Hrs./Week=3 Credits)

Unit	Contents	No. of Lectures Allotted
I	**Introduction:** Definition and objectives of Research – Types of research, Various Steps in Research process, Mathematical tools for analysis, Developing a research question-Choice of a problem Literature review, Surveying, synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research – APA Ethics code.	8
II	**Quantitative Methods for problem solving:** Statistical Modeling and Analysis, Time Series Analysis Probability Distributions, Fundamentals of Statistical Analysis and Inference, Multivariate methods, Concepts of Correlation and Regression, Fundamentals of Time Series Analysis and Spectral Analysis, Error Analysis, Applications of Spectral Analysis.	8
III	**Tabular and graphical description of data:** Tables and graphs of frequency data of one variable, Tables and graphs that show the relationship between two variables, Relation between frequency distributions and other graphs, preparing data for analysis	8
IV	**Soft Computing:** Computer and its role in research, Use of statistical software SPSS, GRETL etc in research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems.	8
V	Structure and Components of Research Report, Types of Report, Layout of Research Report, Mechanism of writing a research report, referencing in academic writing.	8

TEXT BOOKS:

1. C.R. Kothari, Research Methodology Methods and Techniques, 2/e, Vishwa Prakashan, 2006
2. Donald H.Mc Burney, Research Methods, 5th Edition, Thomson Learning, ISBN:81-315-0047-0, 2006.

If the course is available as Generic Elective then the students of following departments may opt it.
NA

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

After completing the course, students should be able to:

1. To understand and comprehend the basics in research methodology and applying them in research/ project work.
2. This course will help them to select an appropriate research design.
3. The course will also enable them to collect the data, edit it properly and analyse it accordingly.
4. To demonstrate the ability to choose methods appropriate to research objectives.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Programme: Doctor of Philosophy (R) **Class: PhD in Electrical & Electronics Engineering**	**Year: I** **Semester: I/II**
Credits: 2 **Theory: 2** **Practical: 0**	**Subject: Research & Publications Ethics**
Course Code: CPE-RPE101	**Title: Research & Publications Ethics**

Course Objective:
1. To know rules, issues, options, and resources for research ethics
2. To familiarize with various institutional ethics review boards/academic integrity guidelines
3. To understand the purpose and value of ethical decision-making
4. To have a positive disposition towards continued learning about research ethics

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 2 Credits

L: 2
T: 0
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (3Hrs./Week=3 Credits)

Unit	Contents	No. of Lectures Allotted
I	• **RPE 01: PHILOSOPHY AND ETHICS (3hrs.)** Introduction to philosophy: definition, nature and scope, concept, branches Ethics: definition, moral philosophy, nature of moral judgments and reaction.	4
II	• **RPE 02: SCIENTIFICCONDUCT (5hrs.)** Ethics with respect to science and research Intellectual honesty and research integrity Scientific misconducts: Falsification, Fabrication, and Plagiarism(FFP) Redundant publications: duplicate and overlapping publications, salami slicing. Selective reporting and misrepresentation of data.	4
III	• **RPE 03: PUBLICATION ETHICS (7hrs.)** Publication ethics: definition, introduction and importance Best practices / standards setting initiatives and guidelines: COPE, WAME, etc. Conflicts of interest Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types Violation of publication ethics, authorship and contributor ship Identification of publication misconduct, complaints and appeals Predatory publishers and journals	4

IV	• **RPE 04: OPEN ACCESS PUBLISHING (4hrs.)** Open access publications and initiatives SHERPA/Ro MEO online resource to check publisher copyright & self-archiving policies Software tool to identify predatory publications developed by SPPU Journal finder/journal suggestion tools viz. JANE, Elsevier Journal Finder, Springer Journal Suggested, etc.	4
V	• **RPE 05: PUBLICATION MISCONDUCT (4hrs.)** **A.** Group Discussions (2hrs.) Subject specific ethical issues, FFP, authorship Conflicts of interest Complaints and appeals: examples and fraud from India and abroad **B.** Software tools (2 hrs.) Use of plagiarism software like Tumitin, Urkund and other open source software tools	4
VI	• **RPE 06: DATABASES AND RESEARCH METRICS (7hrs.)** **A. Databases (4 hrs.)** Indexing databases Citation databases: Web of Science, Scopus, etc. **B. Research Metrics (3hrs.)** Impact Factor of journal as per Journal Citation Report, SNIP, SIR, IPP, Cite Score Metrics: h-index, g index, i10 index, altmetrics	4

TEXT BOOKS:

1. A Handbook of Academic Writing, Murray, R. and Moore, S., Tata McGraw Hill International, 2006.
2. How to Write a Thesis:, Murray, R. Tata Mc Graw Hill, 2nd Edition, 2010.
3. Writing for Publication, Henson, K.T., Allyn & Bacon, 2005.

If the course is available as Generic Elective then the students of following departments may opt it. NA

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	10
2) Presentations /Seminar	-
3) Assignments	5
4) Research Project Report / Seminar On Research Project Report	-
5) ESE	35
Total:	**50**

Prerequisites for the course:

Course Learning Outcomes:

After completing the course, students should be able to:

1. To have a positive disposition towards continued learning about research philosophy & ethics
2. To know Rules, Regulations, Issues, Options, and Scientific Resources of Research Ethics
3. To learn the culture of fairness, honesty and integrity in academic communications and to understand the purpose and value of ethical decision-making
4. Avoid wasteful and duplicate publications & encourage original contributions to advance Academic Research and Scholarship
5. Acquiring knowledge & professional competence and expertise about Patents, Copyrights, and other forms of Intellectual Property Rights

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Programme: Doctor of Philosophy (R) **Class: PhD in Electrical & Electronics Engineering**	**Year: I** **Semester: I/II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Advanced Renewable Energy Engineering**
Course Code: EEE-111	**Title: Advanced Renewable Energy Engineering**

Course Objective:

1. The aims of the degree are to enable the students to: develop detailed knowledge and critical understanding of the core skills in renewable energy resources, converters and systems.
2. To develop and use a significant range of principal and specialist skills, techniques and practices in renewable energy.
3. To develop in-depth knowledge for the following: Various renewable energy resources available at a location and assessments of its potential, using tools and techniques.

Nature of Paper: Discipline Specific Elective Course

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4
T: 0
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (3Hrs./Week=3 Credits)

Unit	Contents	No. of Lectures Allotted
I	**UNIT-I** **Introduction:** Various non-conventional energy resources-Introduction, availability, classification, relative merits and demerits. Solar Cells: Theory of solar cells. Solar cell materials, solar cell array, solar cell power plant, limitations.	8
II	**UNIT-II** **Solar Thermal Energy:** Solar radiation, flat plate collector sand their materials, applications and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.	8
III	**UNIT-III** **Geothermal Energy:** Resources of geothermal energy, thermodynamics of geothermal energy conversion-electrical conversion, non electrical conversion, environmental considerations. Magneto-hydrodynamics (MHD): Principle of working of MHD Power plant, performance and limitations. Fuel Cells: Principle of working of various types of fuel cells and their working, performance and limitations.	8

IV	**UNIT-IV** **Thermo-electrical and thermionic Conversions**: Principle of working, performance and limitations. Wind Energy: Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, and wind characteristics. Performance and limitations of energy conversion systems.	8
V	**UNIT-V** **Bio-mass:** Availability of bio-mass and its conversion theory. Ocean Thermal Energy Conversion (OTEC): Availability, theory and working principle, performance and limitations. Wave and Tidal Wave: Principle of working, performance and limitations. Waste Recycling Plants.	8

TEXT BOOKS:

- Rajaetal., "Introduction to Non-Conventional Energy Resources "Scitech Publications.
- John Twideuand Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
- M. V. R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional" BSP Publications, 2006.
- D.S.Chauhan,"Non-conventionalEnergyResources"NewAgeInternational.
- C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHIL earning.
- Peter Auer, "Advances in Energy System and Technology". Vol.1 & IIE dited by Academic Press.
- Godfrey Boyle, "Renewable Energy Power for A Sustain able Future", Oxford University Press.

If the course is available as Generic Elective then the students of following departments may opt it.
NA

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:
After completing the course, students should be able to:

- To have a positive disposition towards continued learning about renewable energy.
- To know Rules, Regulations, Issues, Options, and Scientific renewable energy engineering.
- To learn the Geo-thermal energy, Thermo-electrical, Bio-mass etc.
- To learn about the Solar Thermal Energy.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Programme: Doctor of Philosophy (R) **Class: PhD in Electrical & Electronics Engineering**	**Year: I** **Semester: I/II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Antenna Theory and Design**
Course Code: ECE-111	**Title: Antenna Theory and Design**

Course Objective:

1. To develop understanding of various types of antenna radiation mechanism.
2. To provide the knowledge of basic understanding of antenna operation through the application of Maxwell's equations.
3. To provide the basic knowledge to calculate array factor of array antennas.
4. To introduce the students various types of antennas and their performance Characteristics.
5. To develop the students' ability to apply modern mathematical techniques to the solutions of antenna problems.

Nature of Paper: Discipline Specific Elective Course

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4
T: 0
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (3Hrs./Week=3 Credits)

Unit	Contents	No. of Lectures Allotted
I	**Fundamental Concepts:** Radiation pattern, near- and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integral and Auxiliary potential functions.	6
II	**Radiation from Wires and Loops:** Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, Small circular loop.	6
III	**Aperture Antennas:** Huygens' principle, radiation from rectangular and Circular apertures, design considerations, Babinet's principle, Fourier transform method in aperture antenna theory.	8
IV	**Hornand Reflector Antennas:** Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegra in antennas	6
V	**Microstrip Antennas:** Basic characteristics, feeding methods, methods of analysis, design of rectangular and circular patch antennas.	6
VI	**Antenna Arrays:** Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays, synthesis of Antenna arrays using Schelkun off polynomial method, Fourier transform method, and Woodward-Lawson method.	8

TEXT BOOKS:

If the course is available as Generic Elective then the students of following departments may opt it.
NA

1. Balanis, C.A., "Antenna Theory and Design", 3rd Ed., John Wiley & Sons 2005
2. Jordan, E.C. and Balmain, K.G., "Electromagnetic Waves and Radiating Systems", 2nd Ed., Prentice-Hall of India 1993
3. Stutzman, W.L. and Thiele, H.A., "Antenna Theory and Design", 2nd Ed., John Wiley & Sons 1998.
4. Elliot, R.S., "Antenna Theory and Design", Revised edition, Wiley- IEEE Press 2003.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

After completing the course, students should be able to:

1. Understand the radiation mechanism of EM waves by antennas and their radiation patterns.
2. Analyze the power radiated by different antennas and their radiation characteristics.
3. Interpret the relationships between antenna parameters.
4. Design and analyze different antennas and antenna arrays.
5. Understand the wave propagation mechanism at different frequencies.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Programme: Doctor of Philosophy (R) **Class: PhD in Electrical & Electronics Engineering**	**Year: I** **Semester: I/II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Advanced EMFT**
Course Code: ECE-112	**Title: Advanced EMFT**

Course Objective:
To introduce the concepts of different coordinate systems, Maxwell`s equations, static electric and magnetic fields and methods of solving for the quantities associated with these fields, time varying fields and displacement current, propagation of electromagnetic waves and their applications in practical problems.

Nature of Paper: Discipline Specific Elective Course

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4
T: 0
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (3Hrs./Week=3 Credits)

Unit	Contents	No. of Lectures Allotted
I	**Electromagnetic waves:** Coordinate systems; Maxwell's equations for time-varying fields and boundary conditions; Poynting vector; Wave equation; Wave polarization; Wave propagation in perfect and los sydielectrics; Reflection of waves on a material boundary; Wave functions.	10
II	**Fundamental Theorem sand Concepts:** Electric and magnetic current sources; Duality; Image theory; Equivalence principle; Babinet's principle; Induction theorem; Reciprocity theorem; Auxiliary potentials; Construction of general solutions from wave functions; Radiation fields.	7
III	**Plane Wave Functions:** Elementary wave functions in rectangular coordinates; T, TM, and hybrid modes in rectangular wave guides; Partially filled waveguides; Rectangular cavity; Modal expansion of fields in a waveguide; Apertures in conducting screens.	8
IV	**Cylindrical Wave Functions:** Elementary wave functions in cylindrical coordinates; Homogeneously filled and partially filled circular wave guides; Radial waveguides; Cylindrical cavities; Sources of cylindrical waves.	8
V	**Spherical Wave Functions:** Elementary wave functions in spherical coordinates; Spherical resonator; Sources of spherical waves.	4
VI	**Wave Propagation in Anisotropic Media:** Plane wave propagation in anisotropic and uniaxial crystals; TEM wave propagation in Ferrites; Faraday rotation.	5

TEXT BOOKS:

If the course is available as Generic Elective then the students of following departments may opt it. NA

1. Harrington, R.F., "Time-harmonic Electromagnetic Fields", Wiley-IEEE Press 2001.
2. Ramo, S., Whinnery, J.R., and Van Duzer, T., "Fields and Waves in Communication Electronics", 3rd Ed., John Wiley & Sons 1994.
3. Collin, R.E., "Foundations for Microwave Engineering", 2nd Ed., John Wiley & Sons 2000.
4. Balanis, C.E., "Advanced Engineering Electromagnetics", Wiley India Pvt. Ltd., Reprint 2008.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

After completing the course, students should be able to:

a. To differentiate different types of coordinate systems and use them for solving the problems of electromagnetic field theory.
b. To describe static electric and magnetic fields, their behavior in different media, associated laws, boundary conditions and electromagnetic potentials.
c. To use integral and point form of Maxwell`s equations for solving the problems of electromagnetic field theory.
d. To describe time varying fields, propagation of electromagnetic waves in different media, Poynting theorem, their sources & effects and to apply the theory of electromagnetic waves in practical problems.
e. To apply concepts of Wave reflection and refraction, Smith Chart in practical Field.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Programme: Doctor of Philosophy (R) **Class: PhD in Electrical & Electronics Engineering**	**Year: I** **Semester: I/II**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Microwave Engineering**
Course Code: ECE-113	**Title: Microwave Engineering**

Course Objective:
To learn the basics principles of various microwave solid state devices. To study the operation and device characteristics of RF Active components. To design and analyze various other Solid State Devices.

Nature of Paper: Discipline Specific Elective Course

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L: 4
T: 0
P: 0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (3Hrs./Week=3 Credits)

Unit	Contents	No. of Lectures Allotted
I	**Transmission Lines and Wave guides:** Review of TEM, TE, and TM mode solutions of Maxwell's equations; TEM mode transmission lines: lossless line, line with small losses, power flow in a terminated line; Quasi-TEM mode lines: Fields in micro strip lines and strip lines, losses in micro strips, micro strip discontinuities, coupled lines, slot lines and coplanar waveguides; Surface wave guides: Surface waves along an impedance plane, dielectric-coated conducting plane, slab waveguide, corrugated plane; Wave velocities.	10
II	**Microwave Circuit Theory Principles:** Equivalent voltages and currents; Z,Y,S, and ABCD parameters; Equivalent circuit representation of microwave junctions; Scattering parameter analysis of microwave junctions; Coupling of wave guides through probes, loops, and apertures.	8
III	**Impedance Transformers:** Review of single-, double-and triple-stubtuners, wave guide reactive elements, quarter-wave transformers, design of maximally flat and Chebyshev transformers; Introduction to tapered transmission lines.	6
IV	**Power Dividers and Couplers:** Scattering matrix of 3- and 4-portjunctions; Design of T –junction and Wilkinson power dividers; Design of 90 and 180 hybrids.	6
V	**Filters:** Analysis of periodic structures, Floquet's theorem, filter design by insertion loss method, maximally flat and Chebyshev designs.	6
VI	**Resonators:** Principles of microwave resonators, loaded, unloaded and external Q, open and shorted TEM lines as resonators, micro strip resonators, dielectric resonators**.**	6

TEXT BOOKS:

If the course is available as Generic Elective then the students of following departments may opt it.
NA

1. Collin, R.E., "Foundations for Microwave Engineering", 2nd Ed., John Wiley & Sons 2000.
2. Pozar, D.M., "Microwave Engineering", 3rd Ed., John Wiley & Sons 2004.
3. Edwards, T.C. and Steer M.B., "Foundations for Interconnects and Micro strip Design", 3rd Ed., John Wiley & Sons 2001.
4. Ludwig, R. and Bretchko, P., "RF Circuit Design", Pearson Education 2000.Hunter, I., "Theory and Design of Microwave Filters", IEE Press 2001.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

After completing the course, students should be able to:

1. Analyze the wave propagation in TE, TM or TEM modes, in structures such as rectangular waveguides
2. Design various microwave components such as power dividers, hybrid junctions, microwave solid state dives, ferrite devices and microwave amplifier
3. Demonstrate various perceive operating principles of basic passive and active microwave devices.
4. perform analysis mathematically the operation and working of the various tubes
5. demonstrate various microwave bench setup for measuring various parameters

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Programme: Doctor of Philosophy (R) **Class: PhD in Electrical & Electronics Engineering**	**Year: I** **Semester: I/II**
Credits: 2 **Theory: 2** **Practical: 0**	**Subject: Renewable Energy simulation software tool**
Course Code: ECE-011	**Title: Renewable Energy simulation software tool**
Course Objective: This course introduces software simulation tools used for modeling renewable energy systems.	
Nature of Paper: Core	
Minimum Passing Marks/Credits: 40% Marks / 2 Credits	
L: 2 T: 0 P: 0 (In Hours/Week) Theory - 1 Hr. = 1 Credit Practical- 2 Hrs.=1 Credit (3Hrs./Week=3 Credits)	

Unit	Contents	No. of Lectures Allotted
I	**Introduction to NOVO PRO Software:** This software is suitable for modeling various combinations of renewable energy sources, storage systems, and backup thermal power. There is an economic module that estimates their capital cost and simulates their annual operating cycle, and overall economics.	7
II	**Introduction to PV syst:** This is more famous for modeling the PV system, however, it also has modules for pumping, and DC-grid (public transportation) PV systems, and includes extensive meteo and PV systems components databases.	7
III	**Introduction to HOMER (Hybrid Optimization Model for Electric Renewables)** Developed by NREL and improved by Homer Energy and can be used for Biomass, Hydro, Combined Heat & Power, Hydrogen, and Advanced Storage.	8
IV	**Introduction to i HOGA / MHOGA:** Hybrid Optimization by Genetic Algorithms (HOGA) software, developed by researchers of the University of Zaragoza (Spain) for the simulation and optimization of Electric Power Generation Systems based on Renewable Energies. It has various modules to simulate the Photovoltaic panels (bifacial and concentrating CPV included), Wind Turbines, Hydraulic turbines, with or without pumped hydro storage (PHS), Fuel cell, H2 tank, Electrolyzer, Batteries, etc.	8

TEXT BOOKS:

If the course is available as Generic Elective then the students of following departments may opt it.
NA

1. https://www.mdpi.com/2073-4425/14/3/570
2. https://www.researchgate.net/publication/358834319_Analysis_And_Design_Of_Solar_PV_System_Using_Pvsyst_Software
3. Irwan, Y. M., A. R. Amelia, Z. Syafiqah, Muhamad Irwanto, M. Farreq, W. Z. Leow, and S. Ibrahim. "Design the Balance of System (BOS) for Photovoltaic Application at CERE Building for Low Load Application: An Application of HOMER Pro." Applied Mechanics and Materials 785 (August 2015): 571–75. http://dx.doi.org/10.4028/www.scientific.net/amm.785.571.
4. https://ihoga.unizar.es/Desc/iHOGA_User_manual.pdf

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	10
2) Presentations /Seminar	-
3) Assignments	5
4) Research Project Report Seminar On Research Project Report	-
5) ESE	35
Total:	**50**

Prerequisites for the course:

Course Learning Outcomes:

After completing the course, students should be able to:

1. Analyze the different-2 software tools for solar pv system.

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I/II

Programme: Doctor of Philosophy (R) **Class: PhD in Electrical & Electronics Engineering**	**Year: I** **Semester: I/II**
Credits: 2 **Theory: 0** **Practical: 2**	**Subject: SEMINAR**
Course Code:ECE-051	**Title : SEMINAR**

Course Objectives: To share information, research findings or expertise on a particular topic or subject matter with a targeted audience.

Nature of Paper: Core

Minimum Passing Marks/Credits: 50% Marks / 2 Credits

L: 0
T: 0
P: 2 (In Hours/Week)
Theory - 0
Practical- 1 Hrs.=1 Credit (3Hrs./Week=3 Credits)

Unit	Contents	No. of Lectures Allotted
	Seminar should be presented on a very recent topic on any technological domain. It should consist of following components: Topic name, introduction, literature reviews, methodology, discussion and conclusion.	

If the course is available as Generic Elective then the students of following departments may opt it.
NA

Evaluation/Assessment Methodology

	Max. Marks
1) Internal	50
Total:	50

Prerequisites for the course:

Course Learning Outcomes:

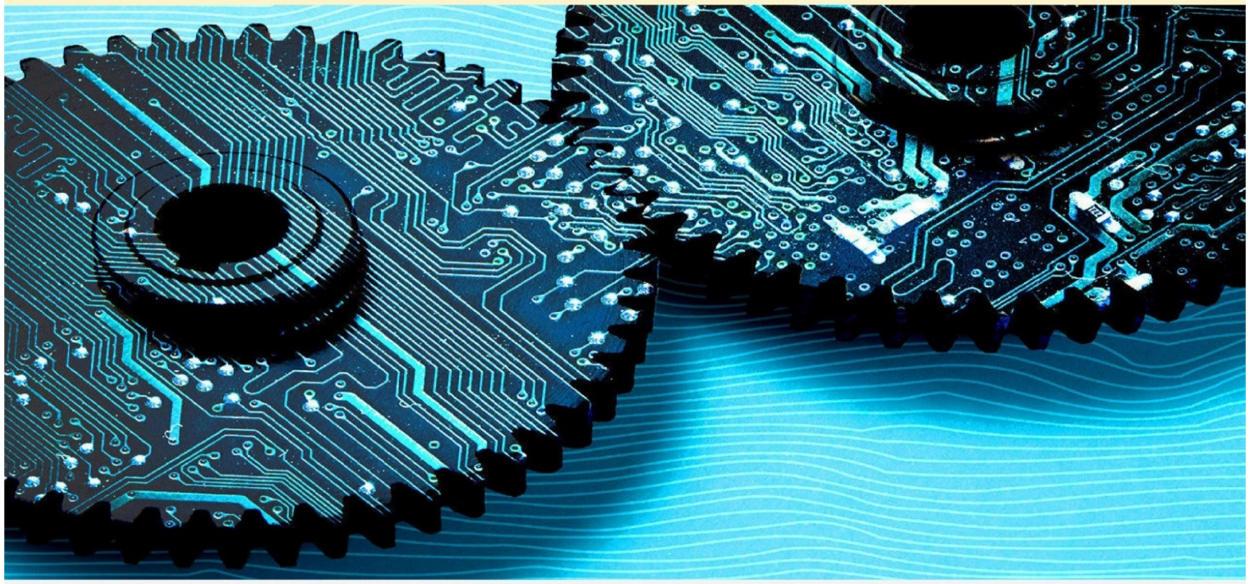
1. Able to share research findings, insights, and knowledge with faculty, and the academic community.
2. Able to demonstrating the seminar topic and showing the proficiency in the chosen area of study.
3. Improve the ability to effectively express the complex technical information to a diverse audience.

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DOCTOR OF PHILOSOPHY
Department of (COMPUTER SCIENCE & ENGINEERING)
(Academic Session 2025-26)

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Evaluation Scheme

Ph.D. (COMPUTER SCIENCE & ENGINEERING)

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SCHEME OF EVALUATION
Ph.D. (COMPUTER SCIENCE & ENGINEERING)

S. NO.	Subject Code	Subject Name	Category	Periods			Marks					Credits
				L	T	P	Internal			Ext	Total	
							CT	TA	Total			
1	RM ENG-101	Research Methodology	CORE	4	0	0	20	10	30	70	100	4
2	CSE-111/ CSE-112/ CSE-113/	Discipline Specific Elective Course (Any one)	DSE	3	1	0	20	10	30	70	100	4
3	CPE-RPE101	Research & Publication Ethics	CORE	2	0	0	10	5	15	35	50	2
4	CSE-011	Information Security simulation software tool	CORE	2	0	0	10	5	15	35	50	2
5	CSE-051	Seminar	Presentation	2	0	0	0	50	50	0	50	2
TOTAL				**13**	**1**	**0**	**50**	**125**	**175**	**175**	**350**	**14**
DISCIPLINE SPECIFIC ELECTIVE COURSE (ANY ONE)												
1	CSE-111	Advances in Information Security	Elective	3	1	0	20	10	30	70	100	4
2	CSE -112	Grid And Cloud Computing	Elective	3	1	0	20	10	30	70	100	4
3	CSE -113	Advanced IOT	Elective	3	1	0	20	10	30	70	100	4

Format-3

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Programme: Ph.D **Class: Ph.D (CSE)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Research Methodology**
Course Code:	**RM ENGG-101**
Course Objectives: To familiarize the research scholar with the fundamentals of scientific research & to gain familiarity about various data collection tools and techniques, data analysis and interpretation along with the application of computer and statistical software in research	
Nature of Paper: Core	
Minimum Passing Marks/Credits: 40% Marks / 4 Credits	
L: 3 T: 1 P: 0 (in Hours/Week) Theory - 1 Hr. = 1 Credit Practical- 2 Hrs.=1Credit(4Hrs./Week=4Credits)	

Unit	Contents	No. of Lectures Allotted
I	Introduction: Definition and objectives of Research – Types of research, Various Steps in Research process, Mathematical tools for analysis, Developing a research question-Choice of a problem Literature review, Surveying, synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research – APA Ethics code.	08
II	Quantitative Methods for problem solving: Statistical Modeling and Analysis, Time Series Analysis Probability Distributions, Fundamentals of Statistical Analysis and Inference, Multivariate methods, Concepts of Correlation and Regression, Fundamentals of Time Series Analysis and Spectral Analysis, Error Analysis, Applications of Spectral Analysis.	08
III	Tabular and graphical description of data: Tables and graphs of frequency data of one variable, Tables and graphs that show the relationship between two variables, Relation between frequency distributions and other graphs, preparing data for analysis	08
IV	Soft Computing: Computer and its role in research, Use of statistical software SPSS, GRETL etc in research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems.	08
V	Structure and Components of Research Report, Types of Report, Layout of Research Report, Mechanism of writing a research report, referencing in academic writing.	08

Text Books

1. C.R. Kothari, Research Methodology Methods and Techniques, 2/e, Vishwa Prakashan,2006
2. Donald H.Mc Burney, Research Methods, 5th Edition, Thomson Learning, ISBN:81-315-0047-0,2006

Reference Books

1. Donald R. Cooper, Pamela S. Schindler, Business Research Methods, 8/e, Tata McGraw-Hill Co. Ltd., 2006.
2. Fuzzy Logic with Engg Applications, Timothy J. Ross, Wiley Publications, 2nd Ed[d]
3. Simulated Annealing: Theory and Applications (Mathematics and Its Applications, by P.J. van Laarhoven & E.H. Aarts[e]
4. Genetic Algorithms in Search, Optimization, and Machine Learning by David E.Gold berg

If the course is available as Generic Elective then the students of following departments may opt it. NO

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	-
4) Research Project Report Seminar On Research Project Report	20
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes:

After undergoing this course, the students will be able to:

CO1-Demonstrate the ability to choose methods appropriate to research aims and objectives
CO2-Understand the limitations of particular research methods
CO3-Develop skills in qualitative and quantitative data analysis and presentation
CO4-Develop advanced critical thinking skills
CO5-Demonstrate enhanced writing skills

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: II

Programme: Ph.D **Class: Ph.D (CSE)**	**Year: I** **Semester: II**
Credits: 2 **Theory: 2** **Practical: 0**	**Subject: RESEARCH & PUBLICATION ETHICS**
Course Code:	**CPE-RPE101**

Course Objectives: This course has total 6 units focusing on basics of philosophy of science and ethics, research integrity, publication ethics. Hands-on-sessions are designed to identify research misconduct and predatory publications. Indexing and citation databases, open access publications, research metrics (citations, h-index, Impact Factor, etc.) and plagiarism tools will be introduced in this course.

Nature of Paper: Core

Minimum Passing Marks/Credits: 40% Marks / 2 Credits

L: 3
T: 1
P: 0(In Hours/Week)
Theory – 1Hr=1 credit
Practical- 2 Hrs.=1Credit(4Hrs./Week

Unit	Contents	No. of Lectures Allotted
I	**Pedagogy :**Class room teaching, guest lectures, group discussions, and practical sessions	10
II	**Evaluation:** Continuous assessment will be done through tutorials, assignments, quizzes, and group discussions. Weightage will be given for active participation. Final written examination will be conducted at the end of the course.	10

If the course is available as Generic Elective then the students of following departments may opt it.
Not applicable

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	30
2) Presentations /Seminar	-
3) Assignments	20
4) Research Project Report/Seminar On Research Project Report	-
5) ESE	100
Total:	**150**

Prerequisites for the course:

Course Learning Outcomes: After undergoing this course, the students will be able to:
CO1: Be aware about the publication ethics and publication misconducts
CO2: Understand the philosophy of science and ethics and research integrity
CO3: Develop hands-on skills to identify research misconduct and predatory publications.
CO4: Differentiate indexing and citation databases, open access publication and research metrics.
CO5: Use plagiarism tools

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Programme: Ph.D **Class: Ph.D (CSE)**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Advances in Information Security**
Course Code: CSE-111	**Title: Advances in Information Security**

Course Objectives:
The Student will Learn:
This course focusses on the models, tools, and techniques for enforcement of security with some emphasis on the use of cryptography. Students will learn security from multiple perspectives.

Nature of Paper: DSE

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0(In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Overview of Networking Concepts: Basics of Communication Systems, Transmission Media Topology and Types of Networks, TCP/IP Protocol Stacks, Wireless Networks, The Internet; Information Security concepts and overview: Background and Current Scenario, Types of Attacks, Goals for Security, E-commerce Security, Computer Forensics, Steganography;	**8L**
II	Security Threats and Vulnerabilities: Overview of Security threats, Weak / Strong Passwords and Password Cracking, Insecure Network connections, Malicious Code, Programming Bugs Cyber-crime and Cyber terrorism, Information Warfare and Surveillance; Cryptography: Introduction to Cryptography, Digital Signatures, Public Key infrastructure, Applications of Cryptography, Tools and techniques of Cryptography	**8L**
III	Security Management: Security Management Practices Overview, Information Classification Process, Security Policy, Risk Management, Security Procedures and Guidelines, Business Continuity and Disaster Recovery, Ethics and Best Practices; Security Laws and Standards: Security Assurance, Security Laws, IPR, International Standards, Security Audit, SSE-CMM / COBIT	**8L**
IV	Information and Network Security: Access Control and Intrusion Detection, Overview of Identification and Authorization, Overview of IDS, Intrusion Detection Systems and Intrusion Prevention Systems; Server Management and Firewalls: User Management, Overview of Firewalls, Types of Firewalls, DMZ and firewall	**8L**

	features;	
V	System and Application Security: Security Architectures and Models, Designing Secure Operating Systems, Controls to enforce security services, Information Security Models; System Security: Desktop Security, Email security-PGP and SMIME, Web Security-web authentication, SSL and SET, Database Security; OS Security: OS Security Vulnerabilities, updates and patches, OS integrity checks, Anti-virus software, Configuring the OS for security; Wireless Networks and Security: Components of wireless networks, Security issues in wireless	**8L**

Reference / Text Books:

1. Principles of Information Security, Michael E. Whitman and Herbert J. Mattord
2. Fundamentals of Information Systems Security, David Kim and Michael G. Solomon

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

After completing the course, students should be able to:

- Understand the networking concept and Security issues.
- Examine and apply the fundamental techniques of computer security. Identify and explain potential security issues.
- Identify and explain risk and potential security issues and policies.
- Demonstrate responsible computer use as it deals with social, political, legal and ethical issues in today's electronic society
- Demonstrate knowledge of the profession, its organizations, goals and leadership roles, literature/publications, issues, and research foundations
- Understand the Security Architectures and Models

Format-3

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Programme: Ph. D **Class: Ph.D- CSE**	**Year: I** **Semester: I**
Credits: 4 **Theory: 4** **Practical: 0**	**Subject: Grid And Cloud Computing**
Course Code: CSE-112	**Title: Grid And Cloud Computing**

Course Objectives:
The Student will Learn:

- Identify the technical foundations of cloud systems architectures.
- Analyze the problems and solutions to cloud application problems.
- Apply principles of best practice in cloud application design and management.
- Identify and define technical challenges for cloud applications and assess their importance

Nature of Paper: DSE

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	**INTRODUCTION** Evolution of Distributed computing: Scalable computing over the Internet – Technologies for network based systems – clusters of cooperative computers - Grid computing Infrastructures – cloud computing - service oriented architecture – Introduction to Grid Architecture and standards – Elements of Grid – Overview of Grid Architecture.	**8L**
II	**GRID SERVICES** Introduction to Open Grid Services Architecture (OGSA) – Motivation – Functionality Requirements –Practical & Detailed view of OGSA/OGSI – Data intensive grid service models – OGSA services.	**8L**
III	**VIRTUALIZATION** Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software - Pros and Cons of cloud computing –Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation.	**8L**

IV	**PROGRAMMING MODEL** Open source grid middleware packages – Globus Toolkit (GT4) Architecture , Configuration – Usage of Globus – Main components and Programming model - Introduction to Hadoop Framework – Map reduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job – Design of Hadoop file system, HDFS concepts, command line and java interface, dataflow of File read & File write.	**8L**
V	**SECURITY** Trust models for Grid security environment – Authentication and Authorization methods – Grid security infrastructure – Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud, Key privacy issues in the cloud.	**8L**

Reference / Text Books:

1. Kai Hwang, Geoffery C. Fox and Jack J. Dongarra, "Distributed and Cloud Computing: Clusters, Grids, Clouds and the Future of Internet", First Edition, Morgan Kaufman Publisher, an Imprint of Elsevier, 2012.
2. Jason Venner, "Pro Hadoop- Build Scalable, Distributed Applications in the Cloud", A Press, 2009
3. Tom White, "Hadoop The Definitive Guide", First Edition. O'Reilly, 2009
4. Bart Jacob (Editor), "Introduction to Grid Computing", IBM Red Books, Vervante, 2005
5. Ian Foster, Carl Kesselman, "The Grid: Blueprint for a New Computing Infrastructure", 2nd Edition, Morgan Kaufmann

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

After completing the course, students should be able to:

1) Explain the core concepts of the cloud computing paradigm: how and why this paradigm shift came about, the characteristics, advantages and challenges brought about by the various models and services in cloud computing.
2) Explain the core concept of Architecture and virtualization of cloud computing.
3) Apply fundamental concepts in cloud infrastructures to understand the service and storage in cloud.
4) Understand the fundamental concepts of Open source grid middleware packages
5) Understand the key security and compliance challenges of cloud computing
6) Analyze various cloud security infrastructure

IIMTU-NEP IMPLEMENTATION
Year: I / Semester: I

Programme: Ph.D **Class: Ph.D CSE**	**Year: I** **Semester: I**
Credits 4 **Theory: 4** **Practical: 0**	**Subject: Advanced IOT**
Course Code: CSE-113	**Title: Advanced IOT**

Course Objectives:
The Student will Learn:
The use of IoT in education enables institutions to perform management tasks faster and risk-free by looking at organized data and taking insights from it to shape decisions.

Nature of Paper: DSE

Minimum Passing Marks/Credits: 40% Marks / 4 Credits

L:3
T:1
P:0 (In Hours/Week)
Theory - 1 Hr. = 1 Credit
Practical- 2 Hrs.=1 Credit (4Hrs./Week=4Credits)

Unit	Contents	No. of Lectures Allotted
I	Internet of Things Promises–Definition– Scope–Sensors for IoT Applications–Structure of IoT– IoT Map Device.	**8L**
II	Industrial sensors – Description & Characteristics–First Generation – Description &Characteristics–Advanced Generation – Description & Characteristics–Integrated IoT Sensors – Description & Characteristics–Polytronics Systems – Description & Characteristics–Sensors' Swarm – Description & Characteristics–Printed Electronics –Description & Characteristics–IoT Generation Roadmap.	**8L**
III	Wireless Sensor Structure–Energy Storage Module–Power Management Module–RF Module–Sensing Module.	**8L**
IV	ACOEM Eagle – EnOcean Push Button – NEST Sensor – Ninja Blocks -Focus on Wearable Electronics	**8L**
V	Creating the sensor project - Preparing Raspberry Pi/ ARM Cortex - Clayster libraries - Hardware-Interacting with the hardware - Interfacing the hardware- Internal representation of sensor values - Persisting data - External representation of sensor values – Exporting sensor data - Creating the actuator project- Hardware - Interfacing the hardware -Creating a controller - Representing sensor values - Parsing sensor data – Calculating control states - Creating a camera - Hardware -Accessing the serial port on Raspberry Pi/ ARM Cortex - Interfacing the hardware - Creating persistent default settings – Adding configurable properties - Persisting the settings - Working with the current settings -Initializing the camera.	**8L**

Reference / Text Books:

1. Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 'Technologies Sensors for the Internet of Things Businesses & Market Trends 2014 -2024',Yole Development Copyrights, 2014
2. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015
3. N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014.

Evaluation/Assessment Methodology

	Max. Marks
1) Class tasks/ Sessional Examination	20
2) Presentations /Seminar	-
3) Assignments	10
4) Research Project Report Seminar On Research Project Report	-
5) ESE	70
Total:	**100**

Prerequisites for the course:

Course Learning Outcomes:

After completing the course, students should be able to:

1. Demonstrate basic concepts of IoT, and understand the principles and challenges in IoT implementation.
2. Understand the functioning of hardware devices and sensors used in IoT.
3. Network communication aspects and protocols used in IoT are part of analysis.
4. Apply IoT for developing real life applications using Ardunio programming.
5. Understand the basic concept of Raspberry Pi/ ARM Cortex - Clayster libraries