SIDDHARTHA
ACADEMY OF HIGHER EDUCATION
A DEEMED TO BE UNIVERSITY
(Under Section 3 of UGC Act, 1956)

SCHEME OF INSTRUCTIONS [SU24]

B.Tech. PROGRAMME

MECHANICAL ENGINEERING

Regulation: SU24

w.e.f. 2024-25

VELAGAPUDI RAMAKRISHNA

SIDDHARTHA SCHOOL OF ENGINEERING

Kanuru, Vijayawada -520 007, Andhra Pradesh

www.siddhartha.edu.in

INSTITUTION VISION

To be a Centre of Excellence in Education, Innovation and Research with Global presence in Arts, Science, Technology, Medicine, Management, Legal and Social Studies in enriching the frontier areas of National and International Importance.

INSTITUTION MISSION

- To create a transformative educational experience for students focused on problem solving skills; communication abilities, and interpersonal relations and leadership.
- To cultivate a vibrant university community for attracting and retaining diverse, world-class talent creating a collaborative environment open to the free exchange of ideas where research, creativity, innovation and entrepreneurship can flourish and ensuring individuals to achieve their full potential
- To impact society in a pragmatic manner— regionally, nationally, and globally — by engaging with industry, outstanding national and international universities and research organizations
- To be a global University that nurtures excellence in education and innovation for creating a knowledgeable society

VISION OF THE DEPARTMENT

To emerge as a globally recognized centre of excellence in Mechanical Engineering education, research, innovation, and entrepreneurship, fostering creativity and advancing sustainable technologies to serve industry and society.

MISSION OF THE DEPARTMENT

- To provide transformative education that equips students with strong fundamentals in mechanical engineering, problem-solving abilities, communication, and leadership skills to meet global engineering challenges.
- To promote innovation and research by cultivating a collaborative environment that encourages creativity, entrepreneurship, and lifelong learning in emerging areas of engineering.
- To strengthen industry–institute interaction through partnerships with industries, research organizations, and global institutions for practical exposure, consultancy, and technology transfer.
- To contribute to society and nation-building by developing competent and ethical mechanical engineers committed to sustainable and inclusive growth.

PROGRAM EDUCATIONAL OBJECTIVES (UG)

We have program educational objectives for our Mechanical Engineering Program. Program educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

PEO 1: Professional Competence

Graduates will develop a strong foundation in mechanical engineering principles and will acquire analytical and problem-solving abilities that will enable them to design, analyze, and implement effective and efficient engineering solutions addressing global technological challenges.

PEO 2: Innovation, Research, and Entrepreneurship

Graduates will engage in research-based activities, innovative practices, and entrepreneurial initiatives to develop sustainable technologies and will contribute to advancements in mechanical engineering and related domains.

PEO 3: Industry Readiness and Societal Contribution

Graduates will build successful careers in industry, academia, and research organizations, and will demonstrate professional ethics, teamwork, adaptability, and a commitment to addressing industrial and societal needs.

PEO 4: Lifelong Learning and Leadership Development

Graduates will pursue continuous learning and professional development, and will strengthen their technical, managerial, and leadership capabilities to remain globally competitive and contribute effectively to organizational and societal growth.

PROGRAM OUTCOMES

On successful completion of the B.Tech Mechanical Engineering Programme the student will be able to:

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

(From Annexure I: Knowledge and Attitude Profile (WK)

WK1: A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.

WK2: Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.

WK3: A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.

WK4: Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.

WK5: Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.

WK6: Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.

WK7: Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.

WK8: Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues

WK9: Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

PROGRAM SPECIFIC OUTCOMES

PSO-1: Analytical and Problem-Solving Skills

Graduates will apply strong analytical abilities, mathematical reasoning, and scientific principles to model, analyze, and solve engineering problems effectively across diverse mechanical and interdisciplinary domains

PSO 2: Mechanical System Design and Analysis

Graduates will be able to apply the principles of design, manufacturing, thermal sciences, and computational analysis tools to develop efficient and sustainable mechanical systems that meet industrial and societal needs.

PSO 3: Modern Tools, Innovation, and Sustainability

Graduates will be capable of using modern engineering tools, simulation software, and emerging technologies to innovate, optimize, and implement sustainable solutions in mechanical and interdisciplinary engineering domains.

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ACADEMIC REGULATIONS

B.TECH DEGREE PROGRAMS – VR SIDDHARTHA SCHOOL OF ENGINEERING

SAHE- B.Tech - SU24

Version 2.0

CONTENTS

PREAMBLE

Siddhartha Academy of Higher Education, an institution Deemed to be University, (SAHE) emphasizes the transformative power of education and the pivotal role of higher learning in fostering an enlightened, equitable, and prosperous society. Established with a commitment to academic excellence, innovative research, and holistic development, SAHE provides a supportive and inclusive environment where diverse ideas thrive, empowering every member to achieve their fullest potential. Guided by principles of integrity, respect, and social responsibility, SAHE aims to contribute meaningfully to the global community for the common good. The University, with its experienced faculty, offers a top-notch education integrating theory and practical skills, preparing students for success in a rapidly evolving world through engaging lectures, hands-on learning, and advanced research opportunities. This document outlines the academic culture, procedures, and regulations of the courses taught at SAHE, specifically for all undergraduate engineering degree programs (B. Tech.), effective from the academic year 2024-25.

1. ABOUT UNIVERSITY

1.1. Introduction

Velagapudi Ramakrishna Siddhartha Engineering College, is the first Private Engineering College in the combined state of Andhra Pradesh, established in 1977. Sponsored by the Siddhartha Academy of General and Technical Education (SAGTE), formed in 1975 by 250 philanthropists, the University aims to promote educational excellence with a holistic approach. Catering to the educational needs of the region, **15 academic institutions** have been established, offering education from kindergarten to postgraduate levels. In 2024, VR Siddhartha Engineering College was declared as Siddhartha Academy of Higher Education (SAHE), an institution deemed-to-be university under Section 3 of the UGC Act, 1956 by Ministry of Education, Government of India. With a legacy of educational excellence, the institution's UGC-granted autonomy, renewed through 2027-28, provides a strong foundation for its transformation. Guided by a detailed 15-year strategic vision and a 5-year rolling implementation plan, Siddhartha Academy of Higher Education focuses on key areas such as academics, faculty recruitment, student admissions, research, ICT infrastructure, and administration, with specific annual milestones and measurable outcomes. SAGTE, as a responsive educational trust, aligns with the Government of India's target of achieving a 50% GER in higher education by 2035. Siddhartha Academy of Higher Education, Deemed-to-be University, offers diverse undergraduate and postgraduate programs through its specialized schools, including the School of Engineering (B.Tech., M.Tech.), School of Management (MBA), School of Law, School of Science (B.Sc.,

M.C.A.), and School of Arts & Commerce (B.Com.). Envisioned to support interdisciplinary and multidisciplinary education for students' holistic development, the university aligns with the aspirations and requirements of NEP 2020 to equip students with the skills and knowledge essential for future growth and societal contributions.

1.2. Vision

"To be a centre of excellence in education, innovation, and research with a global presence in arts, science, technology, medicine, management, legal and social studies in enriching the frontier areas of national and international importance".

1.3. Mission

- To create a transformative educational experience for students focused on problem-solving skills, communication abilities, interpersonal relations, and leadership.
- To cultivate a vibrant university community that attracts and retains diverse, world-class talent, creating a collaborative environment open to the free exchange of ideas where research, creativity, innovation, and entrepreneurship can flourish, and ensuring individuals achieve their full potential.
- To impact society pragmatically - regionally, nationally, and globally - by engaging with industry, outstanding national and international universities, and research organizations.
- To be a global university that nurtures excellence in education and innovation, fostering a knowledgeable society.

1.4. Quality Policy

"The University is committed to pursuing excellence in **academics, innovation, research, and entrepreneurial development** in an **ethical, sustainable, and inclusive manner**, while creating a meaningful societal impact."

2. PURPOSE & SCOPE OF THE REGULATIONS

SAHE'sacademic regulations provide a framework for the functioning of all engineering programs. These regulations include procedures and practices to ensure academic standards, are approved by the Academic Council (AC), and are subject to amendments to meet evolving conditions. These regulations will come into effect from the academic year 2024-25 and apply to all SAHE undergraduate engineering students.

2.1. Academic Regulations

The Academic Regulations provide a framework for academic progress and rules for obtaining a degree from SAHE. The academic administration such as the Registrar, Deans, Controller of Examinations, HoD's of the departments are responsible for the implementation of the regulations. All registered students must agree and abide by these regulations as a condition of enrolment.

2.2. Revision of Regulations

Regulations are published at the start of the academic year and remain in force until a subsequent version is published. Revisions are communicated through circulars and the University website. The Dean of Academics maintains the revised version and the archives of all previous versions.

3. ADMISSION

The admission policy and procedure are revised based on notifications from statutory bodies and government regulations. The number of seats in each degree program is decided based on the approval by regulatory bodies such as AICTE/UGC and government regulations.

To be eligible for undergraduate programs at SAHE, applicants must meet the prescribed eligibility criteria and entrance exam requirements. Students must undertake the Siddhartha Engineering Entrance Examination (SEEE) or qualify from Andhra Pradesh state or national-level entrance exam. Admission is based on merit and availability of seats. SAHE reserves the right to admit any candidate based on specified criteria without discrimination.

3.1. Eligibility for Admission

i. Minimum of 50% marks in Pre-University/Higher Secondary/10+2/Intermediate examination or equivalent from a recognized board with Maths, Physics, and Chemistry as compulsory courses.
ii. A qualifying rank in the Siddhartha Engineering Entrance Examination JEE / (SEEE) / AP EAPCET / TG EAPCET.

3.2. Classification of Admission

3.2.1. Regular Admission

Admission is considered regular if a student of Indian nationality is admitted in the programme's first semester through the SAHE admission test or through any approved entrance exam.

3.2.2. Lateral Admission

Students with a diploma from recognized institutes can join the third semester of the undergraduate program. They must meet the admission criteria for the specific program at SAHE.

3.2.3. Transfer

Students from recognized Higher Education Institutes (HEIs) can be admitted to SAHE without an entrance exam depending on the availability of seats and earning minimum credits as per regulations of SAHE. They must provide transcripts, syllabus copies, educational certificates, and other relevant documents. The Board of Studies (BoS) establishes course equivalency. At least 50% of the program credits must be completed at SAHE to earn the degree from SAHE.

3.3 Scholarships

SAHE offers scholarships based on marks/ranks obtained in entrance exams and other common entrance tests. Scholarships also recognize achievements in academics, sports, culture, and diversity criteria decided by the University.

3.3.1. Scholarship Regulations

i. Scholarships are awarded to recognize achievements and diversity.
ii. The scholarship amount is adjusted towards the tuition fee.
iii. Scholarships are extended subject to a CGPA of 7.5 or above every year in the first attempt of all exams and maintaining 75% and above attendance. The Vice-Chancellor may relax this requirement for diversity or extenuating circumstances.
iv. Recipients should actively participate in societies and clubs and serve as role models.
v. Scholarships will be forfeited in cases of attendance shortage, leave of absence, academic break, academic probation, academic dishonesty, or pending disciplinary action.
vi. Scholarship amounts must be refunded in case of withdrawal from the program.
vii. The University AdmissionsCommittee reserves the right to modify policies.

4. ACADEMIC PROGRAMS

4.1. Nomenclature of Programs

The table lists the B.Techdegree programs offered by the University, along with their abbreviations.

Table 1. Abbreviations

Name of the Program	Abbreviation
Artificial Intelligence (AI) and Data Science (DS)	AI&DS
Civil Engineering	CE
Computer Science and Engineering	CSE
Computer Science and Engineering (Artificial Intelligence and Machine Learning)	CSE(AI&ML)
Computer Science and Engineering (Artificial Intelligence and Data Science)	CSE(AI&DS)
Electronics & Communication Engineering	ECE
Electrical and Electronics Engineering	EEE
Electronics and Instrumentation Engineering	EIE
Information Technology	IT
Mechanical Engineering	ME

Note: "The nomenclature of Artificial Intelligence (AI) and Data Science has been changed to *Computer Science and Engineering (Artificial Intelligence and Data Science)* as per the AICTE Extension of Approval (EOA), Ref. No. South-Central/1-44642791770/2025/EOA, dated 24-Mar-2025, with effect from the academic year 2025-26. Prior to 2025-26 admitted batches, the nomenclature was AI & DS."

4.2. Academic Activities

The Academic Council, chaired by the Vice-Chancellor and comprising Deans, HoDs, selected faculty members, external experts, and special invitees, governs the academic activities of SAHE Deemed to be University. The Council oversees teaching, learning, and evaluation, while academic administrators handle curriculum revision, assessment procedures, and introduction of new programs. The University monitors academic progress, faculty performance, and student discipline, providing guidelines for teaching and learning processes, and framing rules for program implementation, leading to degrees and certificates.

4.3. Semester System

The academic year consists of two semesters: Odd (I, III, V, VII) and Even (II, IV, VI, VIII). The odd semester runs normally from June to November, and the even semester from December to April. The University can accommodate deviations in schedule due to unforeseen circumstances. Students must register for courses each semester, meeting prerequisites. Course syllabi are available on the website and lesson plans and assessment methods are available on the **Learning Management System (LMS).** Continuous and Summative assessments are conducted, and grades are communicated through the student information system.

4.4. Curriculum

The curriculum is developed with input from faculty, students, alumni, parents, industry, and regulatory bodies, ensuring alignment with Vision, Mission, Program Educational Objectives (PEOs) and Program Outcomes (POs).

4.4.1. Program Specifications

- Vision and Mission Statements of the Department
- Program Educational Objectives (PEO)
- Program Outcomes (PO)
- Curriculum/Program Structure: includes various categories of courses and credits

4.4.2. Course Specifications

- Course Information
- Course Description
- Course Aims and Objectives
- Course Structure
- Course Outcomes (CO)
- Mapping of Course Outcomes to Program Outcomes
- List of Text, Reference Books, and Web Resources

4.4.3. Curriculum Preparation:

Faculty members at the Department level shall initiate the discussions on the Programmes to be offered for the ensuing Academic Year based on the stakeholder feedback and market trends. The Program Coordinator consolidates suggestions, and the Department Advisory Board (DAB) reviews

Program Educational Objectives and Program Outcomes. The Board of Studies (BoS) and the Academic Council (AC) approve the curriculum structure and syllabi, with the Head of the Department serving as the Chairperson of the BoS.

4.5. Duration of the Program

4.5.1. Normal Duration

The duration of an academic program shall be four years consisting of eight semesters. The duration of the program for lateral entry students who are admitted in the III semester shall be three years consisting of six semesters.

4.5.2. Maximum Duration

The maximum period that a student can take to complete a full-time academic program shall be double the normal duration of the program, i.e., for regular students, it is eight years, and for lateral entry students,it is six years.

4.5.3. Minimum Duration of a Semester

Each semester consists of a minimum of 90 instruction days excluding examination days.

4.6. Academic Calendar:

The University issues an annual Academic Calendar, considering specific departmental requirements and synchronizing with admission notifications.

5. CURRICULUM FRAMEWORK

The curriculum framework defines the knowledge required for a degree, assigns courses and credits, sequence of courses, and determines the total credits needed for graduation. Each theory course consists of five units.

5.1. Curriculum Structure & Course Categories

The curriculum includes courses that ensure students acquire the necessary knowledge, skills, and attitudes by graduation, aligned with regulatory bodies recommendations. It encompasses various course categories to provide the required depth and breadth for the program, ensuring the attainment of the program's outcomes. There shall be Professional and Open Elective courses to give flexibility to choose courses based on the choice of students.There shall be a limit on the minimum and maximum number of student registrations for these elective courses.

5.1.1. Institutional Core

The Institutional Core comprises courses required for all undergraduate Engineering programs offered by the university. These courses ensure foundational knowledge in the following areas:

a) Basic Sciences and Mathematics (BS)

- This category includes courses in Physics, Chemistry, Biology for Engineers and Mathematics, tailored to the specializations of different departments. Additional courses required by specific departments may also be included.

b) Engineering Sciences (ES)

- This category includes basic courses required from Engineering such as Problem Solving and Programming, Engineering Drawing and Engineering Workshop, etc.

c) Humanities and Social Sciences (HS)

- This includes Communicative English Skills, Engineering Economics & Finance, Universal human values, Elective Courses related to Soft skills, other management courses, etc.

d) Non-Credit Mandatory Courses

- These mandatory courses include an Induction Program, Sports and Yoga or NSS/NCC, Essence of Indian Knowledge Tradition, Constitution of India, Professional Ethics, and Environmental Science, etc.

5.1.2. Professional Core

The Professional core consists of a set of courses considered necessary for the students of the specific program. The courses under this category satisfy the Program Specific Criteria prescribed by the appropriate professional societies/bodies.

5.1.3. Professional Electives

Professional electives are a set of courses offered in the program that cover depth and breadth to further broaden the student's knowledge. The students may register for appropriate electives offered in the program based on their area of interest.

5.1.4. Interdisciplinary Electives

These Electives are offered across the programs to enhance the breadth of knowledge and professional competency of students. Courses offered under this category cover knowledge in emerging areas/technologies. Each department/program shall offer a minimum of two courses. The student can have the flexibility to register for elective courses offered by other Engineering Departments.

5.1.5. Open Electives

Open Electives are offered at the University level. Open Electives include courses from arts, science, humanities, law, and technology streams. These courses enhance the knowledge of the students in other non-engineering and science streams.

5.1.6. Self-Learning Courses

- Self-learning courses refer to educational resources that students can pursue independently, without formal classroom instruction. These courses are typically available online and cover a wide range of topics. Some of the Professional Electives,Interdisciplinary Electives or Open Electives are offered as self-learning courses.

- The self-learning courses can be registered and completed in any one of the approved Massive Open Online Courses**(**MOOCs) such as NPTEL/Swayametc. Students have to submit the certificate before the last Instruction Day of the respective Semester in which it is offered.

- Students can also opt for the Self-Learning courses offered by the school and they have to appear in both continuous and summative assessments conducted by the university.

5.1.7. Engineering Project in Community Services (EPICS), Mini Project, and Major Project

- **Engineering Project in Community Services (EPICS):** The Engineering Project for community services will be carried out during summer vacation for a period of six weeks after the IV Semester and the report shall be submitted in the V Semester. Students will go to the society (Villages/ Hospitals/Towns, etc..) to identify the problem, survey the literature and discuss with the community for a feasible solution. The studentsare encouraged to solve real-life problems.
- **Mini Project**: The Mini Project is carried out duringthe VII semester.Students have to carry out feasibility studies, and literature surveys, and prepare a detailed project report.
- **Major Project:**The Major Project is carried out in the VIII semester and the student can carry out his/her project work in an industry/R&D organization/in the college with well-defined objectives. At the end of the semester, the student shall submit a detailed project report. It involves the preparation and presentation of a report and students are encouraged to publish their work in any research journal/conference.

5.1.8. Industry Interaction (Internship)

- Students shall undergo a mandatory summer internship for a minimum of six weeks duration at the end of the six semester of the Program.

- The internship can be done by students at industries, research labs, construction sites, hydel and thermal power projects, and software companies approved by the school.

- Evaluation of the summer internship shall be through the departmental committee. Students will be required to submit a summer internship report to the concerned department and appear for an oral presentation before the departmental committee.

5.1.9. Personality Development Courses – Soft Skills

The courses offered under this category are aimed to improve the employability skills of the students.

5.1.10. Skill-Oriented Laboratory Courses

Skill-oriented courses, emphasize the development of specific, practical skills rather than the acquisition of theoretical knowledge. Every student shall be given the option to choose either the skill courses being offered by the school/university or a certificate course being offered by industries / Professional bodies or any other accredited bodies as approved by the concerned BoS.

5.1.11. University Common Courses:

These courses are designed to provide students with a well-rounded education and are intended to complement and enhance the specialized knowledge gained in their chosen fields of study. These courses include Design Thinking, AI Tools and Applications, Soft skill courses, professional Ethics, **Humanities Elective Courses such as Project Management, Engineering Economics & mgmt., Innovation, IPR& Entrepreneurship, Operations Research, Industrial Psychology, Finance and Accounting, Organizational behaviour** etc..

5.2. Additional Degree

Students can pursue additional credits for a MINOR or HONORS program along with the major degree to enhance their knowledge and employability opportunities.

5.2.1. Honors Program

A) Offered by the University at the beginning of IV semester

- Students of a Department /Discipline are eligible to opt for Honors Program offered by the same Department /Discipline.
- A student shall be permitted to register for Honors program at the beginning of IV semester provided that the student must have acquired ≥ 8.0 CGPA without backlogs up to the end of the II semester.
- In addition to fulfilling all the requisites of a regular B. TechProgram, a student shall earn 20 additional credits to be eligible for the award of B. Tech (Honors) degree. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e.160credits).

- If a student fails to score the required ≥ 8.0 CGPA without backlogs in subsequent semesters, his/her registration for Honors Program stands cancelled and he/she shall continue with the regular Program.
- Honors must be completed simultaneously with major degree program without exceeding two courses per semester.

B) B.Tech Honors Programmes offered by the university during admission time

- A student shall be permitted to register for **this category of Honors programs at the beginning of I semester.**
- In addition to fulfilling all the requisites of a **regular B. Tech Program**, a student shall **earn 20 additional credits** to be eligible for the award of **B. Tech (Honors) degree.** This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (**i.e.160 credits**).
- The **minimum CGPA or without backlog** condition shall not be applicable for studying Honour Courses in the next higher semester of this programme, subject to the **fulfillment of other academic requirements for promotion to the next semester.**
- The Honors program **must be completed alongside the major degree program** without exceeding **two courses per semester**.
- The **Examination and Evaluation** Procedure for **Honors courses is similar to the regular courses**.
- The **attendance for the registered courses** under Honors and **regular courses offered for Major degree** in a semester are to be **considered separately.**
- This Honors will be mentioned in the degree certificate as **Bachelor of Technology (Computer Science and Engineering or Information Technology etc..) with Honors in Cloud Engineering / Cyber Security etc..**

5.2.2. Minor Program

- Undergraduate students can earn a minor specialization in a different department/ discipline by securing an additional 20 credits. For example, a Mechanical Engineering student can pursue a Minor degree in Computer Science and receive a degree as B.Tech in Mechanical Engineering with a Minor in Computer Science.

- A student shall be permitted to register for the Minor program at the beginning of IV semester, provided that the student must have acquired ≥ 7.0 CGPA up to the end of II semester without any history of backlogs.
- If a student fails to score the required ≥ 7.0 CGPA without backlogs in subsequent semesters, his/her registration for Minors Program stands cancelled and he/she shall continue with the regular Program.
- Minors must be completed simultaneously with major degree program without exceeding two courses per semester.

5.3. Course Numbering Scheme

The course numbering scheme consists of seven alphanumeric places. The scheme is as follows:

First two digits: Regulation year

Third and fourth places: Department offering the course

Fifth digit: Level of the course (1-8, where 1-4 for undergraduate years, 5-6 for PG years, and 7-8 for research level)

Sixth and Seventh digits: Course number (for theory courses up to 80, and above80 for Lab courses)

Example: **24CE105**

- Year of Regulation: 24
- Department: Civil Engineering (CE)
- Level of the Course: 1 (First-year B.Tech)
- Serial Number of the Course: 05, five indicates theory course.

Table2. Nomenclature for course number

Year of Regulation	**DepartmentOffering the Course**	**Level of the Course**	**Serial No. of the Course**
24	CE (Civil Engineering)	1	**05**
2 digits	2 places	1 digit	2 digits
The first two digits indicate the year of regulation	Course Domain: AI - Artificial Intelligence (AI) and Data Science(DS), CE - Civil Engineering, CS - Computer Science and Engineering, EC - Electronics and Communication Engineering, EE - Electrical and Electronics Engineering, EI - Electronics and Instrumentation Engineering, IT - Information Technology, ME - Mechanical Engineering, MA - Maths, PH - Physics, CY - Chemistry, EN – English, HS - Humanities and Social Science, SM - Business School, SL - Law, ED – Education. CA – Computer Applications BY -Biology EO- Economics CO – Commerce TL -Telugu HI – Hindi UC- University Common	1-- I-year UG, 2--II-year UG, 3--III-year UG, 4--IV-year UG, 5-- I- year PG, 6-- II-year PG, 7,8- Research level	01 02 : : 80 For theory courses, ------- 81 : : 99 For Lab or project courses

5.4. Scheme of Instruction and Examination

The scheme of instruction and examination for all B.Tech programs is provided separately in the curriculum books.

5.5. Medium of Instruction and Examination

The medium of instruction and examination is English.

5.6. Fast Track System

- Flexibility is extended to the fast-learning students to take the courses of higher semesters in advance as per their interest.
- Regular students in a 4-year program, with no backlog courses and a CGPA of at least 7.0 up to the $(n-2)^{th}$ semester, are eligible to opt for this flexibility upon entering the n^{th} semester.
- Lateral entry students (3-year duration) with 70% Marks in their Diploma are eligible to opt for this flexibility during IV semester. These students, entering into V/ VI /VII semester with no backlog courses and a CGPA of at least 7.0 up to the $(n-2)^{th}$semester, are eligible to opt for this flexibility upon entering the n^{th} semester.
- List of additional courses offered in the even and odd semesters and the registration dates will be notified by the respective departments well in advance.
- Minimum number of students required to register for an additional course shall be decided by the Departments.
- The registered additional courses will be dealt separately as individual courses for the calculation of attendance and continuous assessment marks for assessing the eligibility to write the summative assessment for these courses.
- A maximum of two courses in one semester are allowed in Fast Track System.
- Mini and Major project courses are not allowed for Fast Track System.
- The rules and regulations for continuous assessment and summative assessment for these courses are similar to the other regular courses.

6. CREDIT SYSTEM AND GRADE POINTS

6.1. Credit Definition

Credits represent quantified and recognized learning, measured in contact periods per week in a semester. Typically, one credit is assigned to:

- A theory or tutorial course conducted for one contact period per week.
- A laboratory course conducted for two contact periods per week.

6.2. Credit Structure

A typical credit structure for B.Tech. coursework, based on the above definitions, is as follows:

Table 3. Credit Definition

Course Component	Credits
1 Hr. Lecture (L) per Week	1 credit
1 Hr. Tutorial (T) per Week	1 credit
1 Hr. Practical (P) per Week	0.5 credit

6.3. Semester Course Load

The average course load is 20 credits per semester, with a minimum of 12 and a maximum of 24 credits.

6.4. Grade Points and Letter Grades for a Course

Grading is based on the evaluation of each course for 100 marks. Marks obtained are converted to a corresponding letter grade as shown in Table 4.

Grade Point: A numerical weight allotted to each letter grade on a 10-point scale.

Letter Grade: An index of student performance in a course is denoted by alphabets.

Grading System for B.Tech Theory / Lab / Project:

Table 4. Marks, Grade points, and Grades

Marks (Theory)	Marks (Lab/Project)	Grade Points	Letter Grade	Grade Description
90% and above	90% and above	10	Ex	Excellent
80 to < 90%	80 to < 90%	9	A+	Very Good
70 to < 80%	70 to < 80%	8	A	Good
60 to < 70%	60 to < 70%	7	B+	Above Average
50 to < 60%	55 to < 60%	6	B	Average
40 to < 50%	50 to < 55%	5	C	Below Average
< 40%	< 50%	0	F (Fail)	Fail
ABSENT	ABSENT	0	AB	--
--	--	NA	S	Satisfactory (Non-Credit courses)
--	--	NA	U	Unsatisfactory (Non-Credit courses)

6.5. Semester Grade Point Average (SGPA) and Cumulative Grade Point Average(CGPA)

i. **Semester Grade Point Average (SGPA):** The Semester Grade Point Average (SGPA) is calculated as the ratio of the sum of the product of the number of credits and the grade points scored in all the courses taken by a student to the sum of the number of credits of all the courses undertaken by the student in that semester. It is expressed as:

$$\text{SGPA}=\frac{\sum(\mathbf{C_i} \times \mathbf{G_i})}{\sum \mathbf{C_i}}$$

where $\mathbf{C_i}$ is the number of credits of the $\mathbf{i^{th}}$ course and $\mathbf{G_i}$ is the grade point scored in the $\mathbf{i^{th}}$ course.

ii. **Cumulative Grade Point Average (CGPA):** The Cumulative Grade Point Average (CGPA) is computed similarly, considering all the courses taken by a student across all semesters of a program. It is expressed as:

$$\text{CGPA}=\frac{\sum(\mathbf{C_i} \times \mathbf{S_i})}{\sum \mathbf{C_i}}$$

where $\mathbf{S_i}$ is the SGPA of the $\mathbf{i^{th}}$ semester and $\mathbf{C_i}$ is the total number of credits in that semester.

- Both SGPA and CGPA shall be rounded off to two decimal points and reported in transcripts.
- Courses in which a student is awarded zero grade points will be included in the SGPA/CGPA calculations.

6.6. Conversion Formula for CGPA to Percentage of Marks

The approximate equivalence of marks to a given CGPA is calculated using the formula:

Percentage Equivalence of CGPA = (CGPA−0.75)×10

7. EXAMINATIONS & SCHEME OF EVALUATION

7.1. Description of Evaluation

Continuous Assessment (CA): Students' performance is evaluated continuously throughout the semester by the faculty or course coordinator using various methods including class tests, sessional examinations, project reviews, viva voce, laboratory assessments, and other activities covering the entire syllabus of the course.

Summative Assessment (SA): SA is conducted by controller of examinations at the end of each semester, as per the academic calendar and with a written examination for theory courses **and practical/project examination, with oral component for laboratory/project courses.**

7.2 Theory Courses

Assessment of a student's performance in theory courses consists of two components.

a) Continuous Assessment:40% weightage.
b) Summative Assessment:60% weightage.

a) Continuous Assessment: 40 Marks

- Two class tests each for 10 marks will be conducted for 45-minute duration. The class test marksshall be awarded with 2/3 weightage for the higher-scoring test and 1/3 for the lower-scoring test.
- Two Sessional examinations each for 20 marks, will be conducted for 75-minute duration. Sessional Marks are awarded with 2/3 weightage for the higher-scoring sessional test and 1/3 for the lower-scoring sessional test.
- 10 marks are allotted for Home Assignments, Quizzes, Presentations and any other mode specified for the course providing exposure to broader course concepts.

b) Summative Assessment: 100 Marks

- The Summative Assessment shall be conducted for a 3-hour duration for 100 marks with a weightage of 60%, at the end of the semester. The question paper consists of Part A with a weightage of 20 marks (short answer questions) and Part B with a weightage of 80 marks.

7.3 Non-Credit Mandatory Courses

These courses carry 100% weightage in Continuous Assessment. No Summative Assessment will be conducted for these courses.

Non Credit Mandatory Theory Course Continuous Assessment: 100 Marks

a) Two sessional examinations each for 40 marks will be conducted for120 minutes duration.
b) 20 marks are allotted for home assignments/seminars.

Non Credit Mandatory Lab Course Continuous Assessment: 100 Marks

a) Activity reports submission at the end of the semester each for 10 marks, maximum of 80 marks.
b) 20 marks are allotted Viva voce/ Quiz.

7.4 Skill-Oriented Laboratory Courses

a) Skill-oriented courses offered by external agencies:

- Students shall register for courses offered by external agencies (such as Industry, Professional Bodies, or other accredited bodies) for a period of 8 weeks or 30 contact hours.
- No continuous assessment will be conducted for these courses. A departmental committee will evaluate the grades or marks given by external agencies for skill-oriented courses and convert them to equivalent marks or grades.

b) Skill-oriented courses offered by the college:

- These courses are considered as Laboratory Courses.
- Students can choose skill-oriented courses offered by the college. Attendance for these courses will be included in the calculation of mandatory attendance requirements.
- Continuous assessment will be conducted during the semester, accounting for 60 marks.
- A summative assessment will be conducted by the respective department at the end of the semester for 100 marks with a weightage of 40%.

-

7.5 Laboratory Courses

a) **Continuous Assessment**: 60% weightage.

- The Laboratory courses are assessed under Continuous Assessment for a maximum of 60 marks. Assessment in laboratory courses comprises of components such as day to day work, record/ drawing sheets submission and viva voce/ quiz on the experiment.
- Regular Class work 40 Marks - Each Class 10M*….10classes (10x10x0.4 = 40M)
- One mid exam- 20 Marks (Procedure/code 5M, Expt./Exec.& Result -10M Quiz/viva -5M)

b) **Summative Assessment**: 40% weightage.

- The Summative Assessment for laboratory courses shall be conducted for three-hour duration at the end of semester for 100 marks with 40% weightage.
- Assessment in laboratory courses comprises of components such as procedure, execution, result and viva voce on the experiment.
- Summative Assessment of Laboratory courses shall be conducted by examiners recommended by the HoD and appointed by Dean of School.

7.6 Integrated Course

An Integrated Course, comprising both theory and laboratory components, undergoes a specific method of evaluation:

Continuous Assessment for Theory component (40 Marks)

- Two class tests each for 10 marks will be conducted for 45-minute duration. The class test marks shall be awarded with 2/3 weightage for the higher-scoring test and 1/3 for the lower-scoring test.
- Two Sessional examinations each for 20 marks, will be conducted for 75-minute duration. Sessional Marks are awarded with 2/3 weightage for the higher-scoring sessional test and 1/3 for the lower-scoring sessional test.

- 10 marks are allotted for Home Assignments, Quizzes, Presentations and any other mode specified for the course providing exposure to broader course concepts.

Continuous Assessment for Lab component (40 Marks)

1. Regular Class work **10 Marks** Each Class 10M*….10classes (10x10x0.1 = 10M)

2. One mid **exam of lab by other faculty member of the department** / University -- **30 Marks**
(Procedure/code 10**M**: Expt./Execution &Result -**15M** Quiz/viva -**5M**)

a) Final Continuous Assessment Marks for Integrated Courses: 40 Marks

a) If a course carries **4 credits** with **L: T: P = 3-0-2**, then:

- **Theory component Marks** = Obtained Theory component Marks × 3/4
- **Lab component Marks** = Obtained Lab component Marks × 1/4

b) If a course carries **3 credits** with **L: T: P = 2-0-2**, then:

- **Theory component Marks** = Obtained Theory component Marks × 2/3
- **Lab component Marks** = Obtained Lab component Marks × 1/3

c) If a course carries 4.5 **credits** with **L: T: P = 3-0-3**, then:

- **Theory component Marks** = Obtained Theory component Marks × 3/4.5
- **Lab component Marks** = Obtained Lab component Marks × 1.5/4.5

Total Continuous Assessment Marks for Integrated Course =

Theory component Marks + Lab component Marks

Weightage is given proportionally based on the credit allocation between **Theory and Lab** components of the integrated course.

b) Summative Assessment: 100 Marks

The Summative Assessment shall be conducted for a 3-hour duration for 100 marks with a weightage of 60%, at the end of the semester. The question paper consists of Part A with a weightage of 20 marks (short answer questions) and Part B with a weightage of 80 marks.

✓ **Summative Assessment will be conducted for the theory part only in integrated courses.**

7.7 EPICS, Mini Project & Major Project

a) **Continuous Assessment**:60% weightage.

- Students can perform EPICS, Mini Project & Major Project individually or in a group (not exceeding five members). These works are assessed under continuous evaluation for 60 marks. Continuous Assessment includes weightages for day-to-day work and periodic reviews by a committee appointed by HoD.

b) **Summative Assessment**:40% weightage.

- The Summative Assessment for EPICS, Mini Project & Major Projectshall be conducted at the end of semester for 100 marks with a weightage of 40%. Summative assessment includes weightage for report preparation, oral presentation and final viva voce.
- Summative Assessment of EPICS and Mini Project shall be conducted and evaluated by the internal committee appointed by the HoD.
- However, the summative assessment for Major Project shall be evaluated by an external examiner nominated by Dean of School.

7.8 Internship

a) **Continuous Assessment**:60% weightage.

- For internships, the student shall submit individual internship report on the successful completion of the training.
- Internships are assessed under continuous evaluation for 60 marks. Periodic reviews are conducted under continuous assessment by coordinator in the industry/laboratory and a committee appointed by the HoD.

b) **Summative Assessment**:40% weightage.

- The Summative Assessment for Internship shall be conducted at the end of semester for 100 marks with a weightage of 40%. Summative assessment includes weightage for report and final viva voce.
- Summative Assessment of Internship shall be conducted and evaluated by the committee appointed by the HoD.

7.9 Self-Learning Courses

a) MOOCs Courses

Students can register and complete the opted course in any one of the approved MOOCs platforms. These courses can be chosen from the list of approved MOOCs providers (SWAYAM / NPTEL).

While choosing the courses, the following norms are to be observed.

- Minimum duration of the course shall be 12 weeks for a 3 credit course and can be a combination of related courses with a total duration of 12 weeks.
- The courses shall not be a part of the curriculum and must be approved by the respective Boards of Studies.
- Students who have qualified in the examination conducted by the MOOC providers are exempted from appearing in the continuous and summative assessment conducted by the University in that category.
- In case a student fails to complete the MOOCs course, he/she may be allowed to register again for the same/ alternative course from the list approved by the department. However, the students have to register with the examination section for submitting the completed MOOCs certificates.

b) Self-Learning courses provided by University

- For the courses under this category, those students who have not registered under MOOCs platform and are able to learn by self-study shall appear for Continuous assessment with 40% weightage and summative assessment with 60% weightage conducted by the University.
- Attendance is not considered for self-learning courses.

7.10. Requirement for Pass

- A student shall be declared to have passed in a theory course if he/she secures a minimum of 40% aggregate marks (Continuous assessment & summative assessment marks put together), subject to a minimum of 35% marks in summative assessment.
- A student shall be declared to have passed in a laboratory course/ EPICS/Internship/Mini Project/Major Project if he/she secures a minimum of 50% aggregate marks (Continuous assessment &Summative assessment marks put together), subject to a minimum of 40% marks in summative assessment.

- A Student shall be declared to have passed in integrated course if he / she secure a minimum of 40% aggregate marks (Continuous Assessment & Summative Assessment marks put together) subjected to a minimum of 35% marks in Summative Assessment.
- A student shall be declared to have passed in a **non credit mandatory course** if he/she secures a minimum of 40% aggregate marks for theory courses and 50% for practical courses in the Continuous assessment. Summative assessment is not done for **non credit mandatory courses.**
- A student has to pass the failed course by appearing in the supplementary examination as per the requirement for the award of a degree.
- On passing a course of a program, the student shall earn assigned credits for that Course.

7.11. Announcement of Results

The Controller of Examinations (CoE) will announce the results at the end of each semester. Students will be able to access their grades in the Student Information System.

7.12. Revaluation

- **Continuous Assessment**
  - The Continuous Assessment scripts shall be shown to the students before finalizing the marks. If any student has a grievance, not addressed before the finalization of marks, he/she may apply for revaluation to the concerned head of the department.
  - The Head of the Department may constitute a two-member committee for re-evaluating the script. The evaluation of the committee is final and binding.

- **Summative Assessment**
  - Students can submit applications for revaluation, along with the requisite fee receipt for revaluation of his/her answer script(s) of theory course(s), as per the notification issued by the Controller of Examinations, if he/she is not satisfied with marks obtained.
  - The Controller of Examinations shall arrange for re-evaluation of those answer script(s).
  - A new external examiner, other than the first examiner, shall re-evaluate.

7.13. Malpractices

- The Dean of school shall refer the cases of malpractices in summative assessment to a Malpractice Enquiry Committee, constituted by him/her for the purpose. Such committee shall follow the approved scales of punishment. The Dean shall take necessary action, against the erring students based on the recommendations of the committee.
- The cases of malpractices in Continuous assessment tests (both Theory and Practical) shall be resolved by the Head of the Department.
- If the Student have any grievance on the decision of the Head of the Department, he/she may appeal to the Deanof the school in the case of Continuous assessment tests.
- Any action on the part of a student at an examination trying to get undue advantage in the performance or trying to help another, or derive the same through unfair means is punishable according to the provisions contained here under.
- The involvement of the Staff, who are in charge of conducting examinations, valuing examination papers and preparing/keeping records of documents relating to the examinations, in such acts (inclusive of providing incorrect or misleading information) that infringe upon the course of natural justice to one and all concerned at the examination shall be viewed seriously and recommended for award of appropriate punishment after thorough inquiry.
- The complete information regarding offense and punishment is available with CoE.

7.14. Compensatory class tests and sessional examinations in Continuous Assessment

A Compensatory Class Test/Sessional examination will be conducted for those students who remained absent for the TEST due to valid/ unavoidable circumstances.

- Student seeking permission on account of accident or severe illness, which disables the student from writing the examination should inform the respective department authorities (Proctor/HoD) immediately through email or mobile message and submit a permission request. Afterwards,he/she should submit a medical certificate from a recognized doctor.
- Student seeking permission on account of a calamity in the family (first relation only-Parents, Grandparents, and Siblings) barring the student from writing the examination should inform the respective department authorities (Proctor/HoD) immediately through email or mobile message and submit a permission request.
- Students seeking permission on account of their participation in important curricular/ co-curricular/ extra-curricular activities/Off-Campus Placements should obtain prior approval from the respective department authorities (Proctor/HoD). After such an event,

the student must submit the participation certificate from the competent authority at the time of reporting to the College.

- All the above requests shall be verified and approved by a committee constituted by Dean of school and then only permitted to write the compensatory test.

7.15. Grant of Attendance Benefit

7.15.1. Attendance benefit for participation in Curricular/Co-Curricular&Extracurricular activities

- The students shall get a minimum attendance of 75% from all the courses put together offered during a semester to become eligible for appearing in summative assessment.
- However, the cases of students who participate in various important Curricular/Co-Curricular/ Extra-curricular activities organized at University/ State/ National/ International levels/Off-Campus Placements representing the college shall be considered and given due consideration for attendance benefit.
- The benefit of attendance may be allowed only based on the production of a certificate from the organizer of the event. However, the total period of absence in the case of state/national level sports events is 30 days and the period of absence in international sports events is 45 days including the Journey period in an academic year as per the UGC letter dated 18-08-1994.
- The committee headed by the Deanof school and two professors as members will scrutinize the request of a student for grant of attendance.

7.15.2. Attendance benefit for Entrepreneurship at College level

A committee with the Dean of school as the chairman, an external member (preferably from industry), two internal members, and the respective HoD as the member secretary will evaluate the students who are involved in entrepreneurship activities and decide on awarding 5% grace marks in continuous assessment and 20% attendance.

7.16. Improvement of Continuous Assessment Marks

- A student **who fails** in a **theory or laboratory course**, due to a **less Continuous Assessment marks** shall be eligible to apply for **improvement of Continuous Assessment marks**.

- The facility for **improvement of Continuous Assessment marks** is intended only to provide an **opportunity for students** to fulfill the minimum academic requirements for **passing the concerned course**.
- A **maximum of two courses** are permitted under this provision. Only **one attempt** is permitted for **improvement in any given course.**
- The **Controller of Examinations** will issue a notification regarding the list of eligible students for **B.Tech. Courses** – After completion of the III Year **(after VI semester)**
- In case the **marks obtained** through this are **lower than the original marks,** the **original marks shall be retained.**
- The improved Continuous Assessment marks will be **considered for subsequent supplementary summative assessments as and when conducted.**
- Students can improve their **continuous assessment marks by self-study** and by **attending all the continuous assessments of a course**. They have to pay the requisite fee.
- If any student fails in their **final year courses due to a shortage of Continuous Assessment marks** and has not previously utilized this provision, they shall also be eligible to avail it at the **end of the last semester**.

8. ACADEMIC PROGRESSION

8.1. Criteria to Attend Summative Assessment and Promotion to Higher Semester

8.1.1. Eligibility for Summative Assessment

a) **Attendance (Minimum: 75%)**

- A student shall be eligible to appear for Summative Assessment if he/she acquires a minimum of 75% attendance in aggregate of all the courses (Theory, Drawing, Laboratory, EPICS, Mini & Major project) in a semester.
- Condonation of shortage in attendance may be recommended by respective Heads of Departments on genuine medical grounds, provided the students put in at least 65% attendance and the Dean of school is satisfied with the genuineness of the reasons and conduct of the student.
- A student will not be promoted to the next semester unless he/she satisfies the attendance requirements of the present semester, as applicable. They may seek readmission for that semester when offered next.
- A stipulated fee shall be payable towards condonation of shortage of attendance to the school/ university.

b) **Marks (Minimum: 50%)**

- A minimum of 50% aggregate marks from all courses in that semester (except self-leaning, mandatory courses and internship) is required by a student in continuous assessment to be eligible to appear for semester end examinations.
- However, a shortage of continuous assessment marks up to a maximum of 10% may be condoned by the Dean of school based on the recommendations of the respective Heads of the Departments, if he/she fulfilsthe attendance criteria.
- Students having a shortage of continuous assessment marks up to a maximum of 10% shall have to pay the requisite fee towards condonation.

c) **Registration**:

- Students who are eligible for summative assessment must register for semester end examinations by paying the prescribed examination fees.

- Students who fail to register for the summative assessment shall not be permitted to continue the subsequent semester and have to repeat the semester for which he/she has not registered for summative assessment.

8.1.2. Requirements for Promotion

- A student shall be eligible for promotion to the next Semester of the B.Tech program, if he/she satisfies the requirements as stipulated in Regulations 8.1.1.
- Further, a student shall be eligible for promotion to V / VII Semester of the B.Tech program, if he/she acquires the minimum number of credits as given in Table 5.

Table5: Promotion Criteria

For Admission into	Minimum Credits Required	
	Regular Students	Lateral Entry Students
V Semester	50% of credits up to IV semester	-
VII Semester	50% of credits up to VI semester	50% of credits upto VI semester

Students detained for lack of Credits

- Students detained for not earning minimum credits as per Table 5 shall be promoted to V/VII Semesters if he/she fulfils the credit requirements from all the regular and supplementary examinations held up to IV/VI Semesters till the commencement of the next academic year.

8.2 Supplementary Examinations

- A Student has to pass the failed course by appearing in the Supplementary Summative Assessment. In every semester Supplementary Summative Assessment of even & odd semesters will be conducted.
- Supplementary Summative examinations shall be conducted in courses of each semester four times after the new regulations come into force. There after student has to appear for Supplementary examinations in the equivalent courses as prescribed by the concerned BoS.

Advanced Supplementary Exams

- Students who fail in Theory or Laboratory courses of the VII/VIII semester, can appear for an advanced supplementary examination conducted within one month after the declaration of the revaluation results at the end of 8th semester.
- To appear for the advanced supplementary examinations, one should have no backlogs till VIth semester.
- Students who fail in the advanced supplementary examinations in the VII/VIII semester shall appear for subsequent examinations when they are conducted in regular manner.

8.3 Readmission Criteria

8.3.1 Readmission after Detention

Detention due to lack of attendance/marks

- A student detained in a semester due to lack of attendance/marks, has to obtain written permission from the Dean of school for readmission into the same semester after duly fulfilling all the required norms stipulated by the University in addition to paying a requisite readmission fee.

Detention due to lack of credits

- A student who is not promoted to the next semester due to lack of credits has to fulfil the minimum requirement of 50% credits by passing the required courses in subsequent summative assessments for admission into the next semester.

8.3.2 Readmission after Break in Study

- Students, who discontinue their studies for any approved reason, can get readmission into an appropriate semester of the B.Tech program after break-in study, with the prior permission of the Dean of the school and following the transitory regulations applicable to such batch in which he/she joins.
- A requisite readmission fee per each year of break in study in addition to the prescribed tuition and special fee has to be paid by the student to condone his/her break in study.

8.3.3 Gap Year Concept for Student Entrepreneurship in Residence

- The Gap Year facility is extended by the committee chaired by the Dean of school to the outstanding students who wish to pursue entrepreneurship during their course of study with a break of one or two years.

- This is extended to two years at the most and these two years shall not be counted for the calculation ofthe maximum period of graduation.
- Students who avail of gap year facilities should follow transitory regulations.
- Students who have availed gap year facility to pursue entrepreneurship are eligible for the award of first class with distinction, subject to fulfilment of all conditions stipulated in academic regulations.

8.3.4 Calculation of attendance for readmitted students

- Students should submit a written request to the Dean of school, along with a challan paid towards tuition and other fees, for readmission one week before the commencement of the class work.
- Students can obtain the information regarding the date of commencement of class work for each semester on the University notice boards/website.
- Number of classes will be counted from the commencement of class work of the semester and not the date of payment of tuition fee, if he/she has paid the tuition fee after the commencement of class work.

8.4 Transitory Regulations

- A student, detained or discontinued in a semester, on re-admission shall be required to pass all the courses prescribed to the readmitted batch of students. The academic regulations which are in force at the time of his/her admission shall be applicable to them.
- However, the exemption will be given to the students who have already passed courses in the earlier semester(s) as per the regulation he/she was admitted and substitute courses are to be studied under transitory regulation as approved by the Academic Council.

9. AWARD OF DEGREE

9.1 Eligibility for Award of B.Tech. Degree

The B.Tech Degree shall be conferred on a student satisfying the following requirements.

Regular student

- A Regular student (four-year program) should register for **160 credits as** prescribed and earn all Credits from the categories 5.1.1 to 5.1.11.
- Student shall earn a satisfactory grade from the category 5.1.1(d)

Lateral Entry student

- A Lateral Entry student (three-year program) should register **for 120 credits** and earn all Credits from the categories 5.1.1 to 5.1.11.
- Student shall earn a satisfactory grade from the category 5.1.1(d)

9.2 Award of Division

The criteria for the award of division, after successful completion of the program as per Section 10.1 is given in Table 6

Table6:CriteriaforAwardofDivision

CGPA	DIVISION
≥8.0	*First Class with distinction
≥6.75	First Class
≥5.75-<6.75	Second Class
≥5.00-<5.75	Pass Class
<5	Fail

★ First Class with Distinction is awarded only if all courses registered are passed in the first attempt within four years for regular students and three years for lateral entry students.

★ Detained and later continued students and break-in study students are not eligible for the award of First Class with Distinction

★ However, the students permitted for a break in study under the entrepreneurship/start-ups provision will be considered for the award of first class with distinction

★ The students who are absent for the summative assessment only once in his/her duration of the B.Tech program on valid medical grounds/humanitarian grounds will be considered for the award of First class with Distinction subject to the recommendations of the committee constituted by the **Vice-Chancellor**. He / She must complete the subjects in

which he/she was absent in a single attempt during a single session conducted at the end of the subsequent semester.

★ The student failing to pass in the mandatory learning courses in the first attempt and pass later as supplementary candidate, may also be awarded "Distinction" akin to other students who pass all the courses at first attempt and fulfil the required conditions for the award of "Distinction".

9.3 Consolidated Grade Card

- A consolidated grade card containing credits & grades obtained will be issued after successful completion of the four-year B.Tech Program.

9.4 Improvement of Cumulative Grade Point Average

- A student, after becoming eligible for the award of Degree, may reappear for the summative assessment to a maximum of three theory courses in a single attempt in one-year duration when conducted, to improve the CGPA and the division.
- But this reappearance shall be within a period of two academic years after becoming eligible for the award of the degree subject to fulfilment of current regulation.
- Students shall not be permitted to reappear for continuous assessment of either theory or laboratory courses.
- This facility shall not be available for students who have taken the Provisional Certificate.
- Modified Grade Cards & Consolidated Grade Card will be issued after incorporating new Grades & Credits and on return of previously issued Grade Cards.

10. ACADEMIC BANK OF CREDITS (ABC)

The Academic Bank of Credits (ABC) is a digital repository of academic credits earned by students throughout their learning journey. It is a centralized system that allows students to transfer credits between institutions and programs, and to accumulate credits over time at their own pace.

The University has implemented Academic Bank of Credits (ABC) to promote flexibility in curriculum as per NEP 2020 to

- provide option of mobility for learners across the universities of their choice
- provide option to gain the credits through MOOCs from approved digital platforms.
- facilitate award of certificate/diploma/degree in line with the accumulated credits in ABC
- execute multiple Entry /Exit option with credit count, credit transfer and credit acceptance from students' account.

11. MULTIPLE ENTRY /EXIT OPTION

- Multiple Entry /Exit Option is a major reform in higher education, introduced in the National Education Policy (NEP) 2020.
- It allows students to exit a program after 1, 2, and 3rd years of study with a relevant certificate, diploma, or degree, and re-enter the same program or a different program at a later time.
- **UG Certificate:** Students who opt to exit after completion of the first year and have secured 40 credits will be awarded a UG certificate if, in addition, they complete one vocational course of 4 credits during the summer vacation of the first year. These students are allowed to re-enter the degree programme within three years and complete the degree programme within the stipulated maximum period.
- **UG Diploma:** Students who opt to exit after completion of the second year and have secured **84 credits in case of regular students, 44 credits in case of lateral entry students,** will be awarded the UG diploma if, in addition, they complete one vocational course of 4 credits during the summer vacation of the second year. These students are allowed to re-enter within a period of three years and complete the degree programme within the maximum period.
- **B Sc (Engg) Degree:** Students who wish to undergo a 3 year UG program will be awarded BSc (Engineering) Degree in the major discipline after successful completion of three years, securing **128 credits in case of regular students, 88 credits in case of lateral entry students.**

12. OTHER MATTERS

- Scribe facility is extended to B Tech students strictly following the guidelines issued under F. No. 16-110/2003-DD.III dt. 26-02-2013 by the Ministry of Social Justice and Empowerment, Department of Disability Affairs, Govt. of India.
- Students suffering from contagious diseases are not allowed to appear for either continuous assessment or summative assessment.
- Students participated in coaching/tournaments held at State/National/International levels through the University / Indian Olympic Association during the summative assessment period will be promoted to subsequent semesters till the entire program is completed as per the guidelines of the University Grants Commission Letter No. F.1-5/88 (SPE/PES), dated18-08-1994.
- Based on recommendations of HoD & Dean of School, exemption from attending the class work is permitted to students who secured placement and intend to **join the job in VIII** semester of B.Tech. Special Continuous Evaluation (Class Tests, Sessional, etc.,) will be arranged for such candidates separately if necessary. However, they shall appear for summative assessment as per the Academic Calendar.
- The Dean of school shall deal with any academic problem, that is not covered under these rules and regulations, in consultation with the Heads of the Departments in an appropriate manner, and approval of Vice Chancellor is obtained and shall be placed before the academic council for ratification.

13. AMENDMENTS TO REGULATIONS

The Academic Council may, from time to time, revise, amend, or change the regulations, schemes of examination, and/or syllabi.

14. DEFINITIONS

- An Academic Program means any combination of courses and/ or requirements leading to the award of a degree.
- “Course” means a subject either theory or practical identified by its course number and course title which is normally studied in a semester.
- “Degree” means an academic degree conferred by the university upon completing the undergraduate curriculum.
- “MOOC” means Massive Open Online Course
- “Regular Students” means students enrolled into the four-year program in the first year.
- “Lateral Entry Students” means students enrolled into the four-year program in the second year.
- “Honors” is an undergraduate bachelor’s degree containing courses of higher standard in a specific domain offered by the same department.
- “Minors” is an undergraduate bachelor’s degree containing courses in a specific domain other than the parent department.

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SIDDHARTHA ACADEMY OF HIGHER EDUCATION

(Deemed to be University)

V R S SCHOOL OF ENGINEERING

SCHEME OF INSTRUCTION FOR FIRST YEAR UG PROGRAMME [VR24]

MECHANICAL ENGINEERING

SEMESTER I — CONTACT HOURS: 29

S.No	Course Code	category	Course Name	L	T	P	Credits
1	24MA101	BS	Mathematics – I (Linear Algebra, Series and Calculus)	3	0	2	**4**
2	24CY103	BS	Chemistry for Engineers (CE/ME)	3	0	0	3
3	24BY101	BS	Biology for Engineers	3	0	0	**3**
4	24CS101	ES	Problem Solving with Python	3	0	3	**4.5**
5	24ME181	ES	Engineering Graphics	1	0	3	**2.5**
6	24CY181	BS	Chemistry lab	0	0	2	**1**
7	24ME182	ES	Workshop Practice	0	0	3	**1.5**
8	24UC183	MC	Sports & Yoga / NSS/ NCC	0	0	3	**0**
	UC- University Common		**Total**	**13**	**0**	**16**	**19.5**

BS- Basic Science HS- Humanities & Social Sciences

ES- Engineering Science MC- Mandatory Course

SEMESTER II — CONTACT HOURS: 29

S.No	Course Code	Category	Course Name	L	T	P	Credits
1	24MA102	BS	Mathematics – II (Differential equations & Computational methods)	3	0	2	**4**
2	24PH103	BS	Physics for Engineers (CE/ME)	3	0	0	3
3	24EN101	HS	Communicative English	3	0	3	**4.5**
4	24ME101	ES	Engineering Mechanics (CE/ME)	3	0	0	**3**
5	24IT101	ES	**Programming using 'C'**	2	0	2	**3**
6	24UC181	ES	Design Thinking	0	0	2	**1**
7	24PH181	BS	Physics lab	0	0	2	**1**
8	24UC182	ES	AI Tools and Applications	0	0	2	**1**
9	24UC101	MC	Essence of Indian Knowledge Tradition	2	0	0	**0**
	UC- University Common		**Total**	**16**	**0**	**13**	**20.5**

BS- Basic Science HS- Humanities & Social Sciences ES- Engineering Science

MC- Mandatory Course

SAHE- B.Tech – SU24 Course Structure (2nd,3rd and 4th years)

Semester-III **CONTACT HOURS: 25**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	24MA201	BS	Probability & Statistics for Engineers(CE/ME)	4	0	0	4
2	24EE211	ES	Electrical and Electronics Engineering	3	0	0	3
3	24ME201	PC-1	Mechanics of Materials	3	0	0	3
4	24ME202	PC-2	Engineering Thermodynamics	3	0	0	3
5	24ME203	PC-3	Kinematics of Machines	3	0	0	3
6	24ME281	PC Lab	Solid Modelling Lab	0	0	3	1.5
7	24EE285	ES	Electrical and Electronics Engineering Lab	0	0	3	1.5
8	24UC201	HS	Universal Human Values-II Understanding Harmony	2	1	0	3
			Total	18	1	6	**22**

Universal Human Values-1 Course is covered in the Induction Program

Red – common course code Violet – code may be replaced by other dept. code

80 Series – Lab/Skill/Epics/project Courses UC – University Common Courses

Semester-IV **CONTACT HOURS: 28**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	24ME204	ES	Engineering Materials & Metallurgy	3	0	0	3
2	24ME205	PC-4	Fluid Mechanics and Hydraulic Machines	3	1	0	4
3	24ME206	PC-5	Dynamics of Machinery	3	1	0	4
4	24ME207	PC-6	Manufacturing Processes	3	0	0	3
5	24ME208	PC-7	Applied Thermodynamics	3	1	0	4
6	24ME282	PC Lab	SM&FM Lab	0	0	3	1.5
7	24ME283	PC Lab	Manufacturing processes Lab	0	0	3	1.5
8	24EN281	HS	Soft Skills-I - English for Professionals	0	0	2	1
9	24UC202	MC	Professional Ethics	2	0	0	0
			Total	17	3	8	**22**
			Minor/Honor's Courses (Optional)	3	0	0	**3**

Red – common course code

80 Series – Lab/Skill/Epics/project Courses UC – University Common Courses

- *Total credits for 2nd year are to be **44.***
- *Credits for the courses Maths, Soft Skills, UHV-II are fixed for all disciplines.*
- *Credits and L-T-P can be adjusted for other courses only to sum up at 44 for the 2nd year.*

Semester-V **CONTACT HOURS: 30**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	24ME301	PC-8	Heat Transfer	3	1	0	4
2	24ME302	PC-9	Design of Machine Elements	3	0	0	3
3	24ME303	PC-10	Robotics	3	0	0	3
4	**24ME360 A,B,C**	IE-1	(Basket of courses for other engineering department students) A. Systems Engineering B. Sustainable Energy Technologies C. Manufacturing Technology	3	0	0	3
5	24ME310 **A,B,C,D**	PE-1	A. Renewable Energy Systems B. Control systems & Mechatronics C. Additive Manufacturing D. Production Planning and Control	3	0	0	3
6	24ME383	PC Lab	Heat Transfer Lab	0	0	3	1.5
7	24ME384	PC Lab	Machine Tools & Metrology Lab	0	0	3	1.5
8	24ME381	PR	EPICS *	0	0	4	2
9	24ME382	PC	Skill Course-I – PLC & Automation Lab	0	0	2	1
10	24UC302	MC	Environmental Science (Non - CSE group)	2	0	0	0
			Total	17	1	12	**22**
			Minor/Honours Courses (Optional)	3	0	0	**3**

- **4 week summer Internship after 4th semester (EPICS)**

Red – common course code Green – code from other dept. Blue- only dept. code will change

Semester-VI **CONTACT HOURS: 29**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	24ME304	PC-11	Design of Transmission Elements	3	1	0	4
2	24ME305	PC-12	Finite Element Method	3	1	0	4
3	**24ME370 A,B,C**	IE-2	(Basket of courses for other engineering department students) A. Smart Materials B. Mechatronics C. Automobile Engineering & EV	3	0	0	3
4	24ME320 **A,B,C,D**	PE-2	**Professional Elective -2** A. Refrigeration and Air Conditioning B. Advanced Mechanics of Materials C. Computer Integrated Manufacturing D. Supply Chain Management	3	0	0	3
5	24ME330 **A,B,C,D**	PE-3	**Professional Elective -3** A. Energy Conservation and Management B. Design for Manufacturing and Assembly (DFMA) C. Non-Conventional Machining Processes D. Lean Manufacturing and Six Sigma	3	0	0	3
6	24ME385	PC Lab	Analysis & Simulation Lab	0	0	3	1.5
7	24ME386	PC Lab	Fuels & IC Engines Lab	0	0	3	1.5
8	24EN381	HS	Advanced communication skills **(Non CSE group)**	0	0	2	1
9	24ME387	PC	Skill Course-II – Robotics &Mechatronics Lab	0	0	2	1
10	24UC301	MC	Constitution of India	2	0	0	0
			Total	17	2	10	**22**
			Minor/Honours Courses (Optional)	3	0	0	**3**

Red – common course code Green – code from other dept. Blue- only dept. code will change

80 Series – Lab/Skill/Epics/project Courses UC – University Common Courses

- *Total credits for 3rd year are to be **44.***
- *Credits for the courses Inter disciplinary Elective, EPICS, Advanced communication skills, Skill Course, Constitution of India / Environmental Science are fixed for all disciplines.*
- *Credits and L-T-P can be adjusted for other courses only to sum up at 44 for the 3nd year.*

Semester-VII **CONTACT HOURS: 23**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	24ME401	PC-13	Machine Tools & Metal Cutting	3	1	0	4
2	24OE410 **A,B,C..**	OE-1	Open Elective – 1 (OE Basket)	3	0	0	3
3	24ME440 **A,B,C,D**	PE-4	**Professional Elective -4** 1. Gas Turbine and Jet Propulsion 2. Composite Materials and Structures 3. Smart Manufacturing Systems 4. Total Quality Management/SQC	3	0	0	3
4	24HE410 **A,B,C..**	HE-1	Humanities Elective – 1 (HE Basket)	3	0	0	3
5	24ME481	PR	Summer Internship	0	0	4	2
6	24ME482	PC	Advanced Skill Course -Fluid flow Simulation Lab	0	0	2	1
7	24ME483	PR	Mini Project	0	0	4	2
			Total	12	1	10	**18**
			Minor/Honours Courses (Optional)	3	0	0	**3**

- **6-week summer Internship after 6th semester**

Red – common course code Blue- only dept. code will change

Semester-VIII **CONTACT HOURS: 22**

S.No	Course Code	Course Category	Course Name	L	T	P	Credits
1	24HE420 **A,B,C..**	HE-2	Humanities Elective – 2 (HE Basket)	3	0	0	3
2	24OE420 **A,B,C..**	OE-2	Open Elective – 2 (OE Basket)	3	0	0	3
3	24ME484	PR	Major Project	0	0	16	8
			Total	6	0	16	**14**

Red – common course code Blue- only dept. code will change

- *Total credits for 4th year are to be 32.*
- *Credits for the courses Open Electives, Humanities Electives, Summer Internship, Advanced Skill Course, Mini Project, Major Project are fixed for all disciplines.*
- *Credits and L-T-P can be adjusted for other courses only to sum up at 32 for the 4th year.*

Humanities Elective Courses
(HE Basket)

Project Management
Engineering Economics & mgmt.
Innovation, IPR& Entrepreneurship
Operations Research
Industrial Psychology
Finance and Accounting
Organizational behavior

+

Any management course offered by SAHE/Online (Swayam / NPTEL) and approved by department

Open Elective Courses
(OE Basket)

Foreign Language
Music
Law

+

Any course offered by SAHE/Online (Swayam / NPTEL) and approved by department

CREDIT DISTRIBUTION- Category wise and Semester wise - **(SU24)**

	BS	**ES**	**HS**	**PC**	**PE**	**IE+OE**	**(Skill)**	**PROJ**	**Total**
Sem-1	11	8.5	0	0	0	0	0	0	19.5
Sem-2	8	8	4.5	0	0	0	0	0	20.5
Sem-3	4	4.5	3	10.5	0	0	0	0	22
Sem-4	4/0	0/4	1	17	0	0	0	0	22
Sem-5	0	0	1/0	14	3	3	(2/1)	2	23/22
Sem-6	0	0	0/1	12	6	3	(1/2)	0	21/22
Sem-7	0	0	3	5	3	3	(1)	4	18
Sem-8	0	0	3	0	0	3	0	8	14
Total	**27/23**	**21/25**	**15.5**	**58.5**	**12**	**12**	**(4)**	**14**	**160**

I SEMESTER

24MA101
Mathematics – I
(Linear Algebra, Series and Calculus)

Course Category:	**Basic Sciences**	**Credits:**	**4**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-2**
Pre-requisites:	**10+2 Mathematics**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description: An overview of the fundamental concepts of linear algebra, infinite series, Differential calculus, multiple integrals and vector calculus, with a focus on the applications in solving engineering problems.

Course Objectives:

- Introduce techniques for solving systems of linear equations, determining Eigen values and eigenvectors, and performing matrix diagonalization.
- Explain methods to analyze the convergence and divergence of an infinite series and to expand functions using Taylor's or Maclaurin's series
- Familiarize differentiation rules and theorems to solve problems related to rates of change and optimization
- Explain the concept of double and triple integrals to calculate areas and volumes for two-dimensional and three-dimensional objects
- Teach operations on vector-valued functions, including line and surface integrals, as well as the concepts of curl and divergence, and their applications in engineering

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Solve the systems of equations and analyze engineering problems using linear algebra techniques	K3
CO2	Apply the convergence tests of an infinite series to solve engineering problems	K3
CO3	Use differential calculus to solve optimization problems and analyze rates of change in engineering applications	K3
CO4	Calculate areas and volumes using double and triple integrals.	K3
CO5	Apply vector calculus concepts to solve problems involving work done by force fields and analyze related physical phenomena	K3

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**2**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**2**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**2**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**2**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**2**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (10 Hours)

Linear Algebra **[T2]**

Rank of a matrix (Echelon form), Finding the inverse by Gauss-Jordan method, System of linear equations: Homogeneous and Non-Homogeneous, Linear transformations, Orthogonal transformation, Eigen values and Eigenvectors, Reduction to Diagonal form

Unit-II (10 Hours)

Infinite Series **[T2]**

Infinite Sequence (Definition), Infinite Series, Comparison Tests, Integral Test, Ratio and Root Test, Alternating Series, Absolute and Conditional convergence.

Unit-III (10 Hours)

Differential Calculus **[T2]**

Mean value theorems: Rolle's theorem (without proof), Lagrange's mean value theorem (without proof), Taylor's and Maclaurin's theorems with Lagrange's form of remainder (without proof), Expansions of functions: Taylor's and Maclaurin's series Functions of Several Variables: Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers

Unit-IV (10 Hours)

Multiple Integral **[T2]**

Double integrals (Cartesian coordinates), Change of order of integration, Triple integrals, Change of variables to polar, cylindrical and spherical coordinates, Areas as double integration and Volumes as triple integration

Unit-V (10 Hours)

Vector Calculus **[T2]**

Introduction to Gradient of a scalar field, Divergence and Curl of a vector field, Line integral, Green's theorem in the plane (without proof), Surface integrals, Stoke's theorem (without proof) and Gauss divergence theorem (without proof)

Text Books:

1. Weir Maurice D., Hass Joel & Giodano Frank R. (2013). *Thomas' Calculus*. (11th Edition). Pearson Education,inc..
2. Grewal B. S. (2017). *Higher Engineering Mathematics*. (44th Edition). Khanna Publishers.

Reference Books:

1. Kreyszig Erwin. (2013). *Advanced Engineering Mathematics*.(9th Edition).Wiley Publishers.
2. Ramana B.V.(2007). *Higher Engineering Mathematics*.Tata Mc.Graw Hill

Web Resources:

MIT OpenCourseWare: Linear Algebra
https://ocw.mit.edu/courses/18-06-linear-algebra-spring-2010/
NPTEL: Linear Algebra
https://archive.nptel.ac.in/courses/111/104/111104137/
MIT OpenCourseWare: Multivariable Calculus
https://ocw.mit.edu/courses/18-02sc-multivariable-calculus-fall-2010/
NPTEL: Engineering Mathematics-I
https://archive.nptel.ac.in/courses/111/105/111105121/

24MA101
LINEAR ALGEBRA, SERIES AND CALCULUS

Course Category:	**HS**	**Credits:**	**1C**
Course Type:	**Integrated Lab**	**Lecture-Tutorial-Practice:**	**0L-0T-2P**
Pre-requisites:	**Mathematics-I**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

An overview of the functions of MathWorks Symbolic Math Tool Box to solve problems in Matrix algebra, differential calculus, multiple integrals, vector calculus and to test the nature of series.

Course Objectives:

1. Find inverse, rank, eigen values, eigen vectors of a matrix and solution of system of linear equations.
2. Analyze the convergence and divergence of infinite series.
3. Find ordinary and partial derivatives
4. Expand functions as Taylor's and Maclaurin's series.
5. Determine extreme values of multi-variable function with and without constraints.
6. Calculate areas and volumes using double and triple integrals.
7. Find gradient, divergent and curl.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes:	BTL
CO1	Find rank, eigen values, eigen vectors of a matrix, solution of system of linear equations.	(K3)
CO2	Examine the convergence/divergence of infinite series	(K3)
CO3	Determine derivatives, series expansion and extreme values of a function	(K3)
CO4	Calculate areas and volumes using double and triple integrals	(K3)
CO5	Find gradient of scalar field, divergence and curl of vector field	(K3)

Course articulation matrix

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2-- Medium, 3 -- High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2			1						
CO2	2	2			1						
CO3	2	2			1						
CO4	2	2			1						
CO5	2	2			1						

Course Content

Unit-I (02 Hours)

`inv()` function to find inverse of a matrix
`rank()` function to find rank of a matrix
`rref()` function to solve system of linear equations
`eig()` function to find eigen values and eigen vectors of a matrix

Unit-II (02 Hours)

`vpa()` function to evaluate numerically each term of series
`symsum()` function to test the nature of the series

Unit-III (02 Hours)

`diff()` function to find ordinary and partial derivatives
`taylor()` function to expand functions as Taylor's and Maclaurin's series
`fmincon()` function to find minimum of a function with constraints

Unit-IV (02 Hours)

`int()` function to find double and triple integrals

Unit-V (02 Hours)

`gradient()` function to find gradient of a scalar point function
`divergence()` function to find divergence of a vector point function
`curl()` function to find curl of a vector point function

Text Books:

Matlab Lab Manual

Web Resources:

- MathWorks Linear Algebra Documentation
  Linear Algebra - MATLAB & Simulink - MathWorks India
- MathWork Symbolic Calculus Tool Box
  Calculus - MATLAB & Simulink - MathWorks India
- MathWork Symbolic Math Tool Box
  Symbolic Math Toolbox Documentation - MathWorks India
- MathWork Optimization Tool Box
  Optimization Toolbox Documentation - MathWorks India
- MathWork Symbolic Calculus Tool Box
  Calculus - MATLAB & Simulink - MathWorks India

24CY103
Chemistry for Engineers

Course Category:	**Basic Sciences**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial- Practice:**	**3-0-0**
Pre-requisites:	**10+2 Chemistry**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

The course is designed for Civil and Mechanical Engineering first year students, providing essential and applied knowledge of Chemistry relevant to their fields. Understanding the specific application of materials based on their characteristic properties, which are determined by their structural and bonding aspects, is crucial for appropriate utilization. With this focus, the course covers the working principles of electrodes, sensors, batteries, and fuel cells, applying principles of electrochemistry. Additionally, it delves into the mechanistic aspects of lubricants and the composition of cement, concrete, composites, refractories, glasses, and alloy steels. Furthermore, the course emphasizes the principles and control methods of corrosion in various metal structures.

Course Objectives:

1. Impart knowledge on the functioning of electrodes, batteries and fuel cells, grounded in electrochemical principles.
2. Analyse various corrosion processes and propose control methods based on corrosion principles.
3. Discuss structural and compositional aspects of engineering materials such as polymers, glasses, and alloy steels.
4. Explore the composition, nature, properties, and applications of different types of cements, concrete, and refractories.
5. Explain the mechanisms and properties of lubricants, and the composition of composite materials, highlighting their engineering applications.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Apply the knowledge of basic electrochemistry principles to electrodes, batteries and fuel cells	**K3**
CO2	Analyse various corrosion processes and control methods	**K4**
CO3	Analyse the dependence of applications of polymers, glasses and alloy steels on their composition, bonding and structures	**K4**
CO4	Correlate the characteristic features of cements, concrete and refractories with chemical composition and chemical reactions involved	**K4**

CO5	Apply the chemical aspects of lubricants and composite materials to assess their engineering applications	**K3**

Course articulation matrix

	POs										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	3	1	2	-	-	-	-	-	-	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-
CO3	3	-	2	1	-	-	-	-	-	-	-
CO4	3	-	2	1	-	-	-	-	-	-	-
CO5	3	-	2	1	-	-	-	-	-	-	-

(1-Low, 2 -Medium, 3–High) (WK1)

Course Content

Unit-I (9 Hours)
Electrochemistry

- Electrodes, electrode potentials and electrochemical cells
- The Nernst equation with numerical problems for calculating electrode potential and emf
- Reference electrodes – Calomel and Ag/AgCl electrodes, Ion-selective electrodes, glass electrode - construction, working, advantages, and disadvantages
- Conductometric analysis (acid-base reactions)
- Batteries, with a focus on lithium-ion ($LiCoO_2$)battery
- Fuel cells, specifically the hydrogen-oxygen fuel cell

Unit-II (9 Hours)
Corrosion and its control

- Introduction to corrosion and its causes
- Electrochemical corrosion: hydrogen evolution and oxygen absorption corrosion
- Differential aeration corrosion
- Scaling and corrosion in boilers and their control
- Galvanic corrosion and its control, including the galvanic series
- Surface coatings: types of metallic coatings
- Hot dipping processes: galvanizing and tinning

Unit-III (9 Hours)
Polymer Chemistry, Glasses and Alloy Steels

- Polymer chemistry: Introduction, types of polymerization, thermoplastics and thermosetting plastics, preparation, properties and applications of PVC, Nylon-6,6, Urea-formaldehyde and Polyurethane.
- Glasses: Composition, types of glasses, properties and engineering applications.
- Alloy Steels: Types of steels, specific effects of alloying elements, industrial applications of alloy steels.

Unit-IV (9 Hours)
Chemistry of Cement and Refractories

- Cement: Composition, manufacture of Portland cement, setting and hardening of cement and chemical reactions involved, concrete and RCC, reactions involved in corrosion of reinforcement steel, degradation and protection of concrete.
- Refractories: Classification and properties – refractoriness, RUL test, porosity, and applications of refractories.

Unit-V (9 Hours)
Lubricants and Composite Materials

- Lubricants: Friction and effects of frictional heat, lubricants, mechanisms of lubrication, types of lubricants based on physical state, properties of lubricants – viscosity, flash and fire points, mechanical stability.
- Composite materials: Constituents of composites, types of composites and engineering applications of composites.

Text Books:

1. Ramesh, S. (2013). *Engineering chemistry* (2nd ed.). Wiley India.
2. ShikhaAgarwal, (2015). *Engineering chemistry: fundamentals and applications*(1st ed.). Cambridge University Press.
3. Jain, P.C.(2018).*Engineering chemistry* (17th ed.). DhanpatRai.

Reference Books:

1. PrasanthaRath, &ArunaKumari, S. (2023).*Engineering chemistry* (1st ed.). Cengage.
2. ArunBahl, Bahl, B. S., &Tuli, G. D. (2020). *Essentials of physical chemistry* (28th ed.). S. Chand.

3. BillmeyerJr, F. W. (2007).*Textbook of polymer science* (3rd ed.). John Wiley & Sons.
4. Haghi, A. K., Mercader, A. G., Balkoese, D., &Mukbaniani, O. V. (2021).*Applied chemistry and chemical engineering*, (1st ed.). CRC Press, Taylor & Francis Group.
5. Skoog, D. A., West, D. M., Holler, F. J.,&Crouch, S. R. (2022).*Fundamentals of analytical chemistry* (10th ed.). Cengage.
6. Fontana, M. G. (2017). *Corrosion engineering* (3rd ed.). McGraw-Hill Education.
7. Taylor, H. F. W. (1997). *Cement chemistry* (2nd ed.). Thomas Telford.

Web Resources:

- https://www.sciencedirect.com/topics/chemistry/electrochemistry
- https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry 20.7: Batteries and Fuel Cells - Chemistry LibreTexts
- https://pesjournal.net/journal/v3-n1/2.pdf
- https://www.researchgate.net/publication/275028997_Corrosion_and_Corrosion_Control
- https://www.snexplores.org/article/explainer-what-are-polymers
- https://books.google.co.in/books/about/Glass_Chemistry.html?id=2yTyCAAAQBAJ&redir_esc=y
- https://kdmfab.com/alloy-steel/
- https://www.mdpi.com/2076-3417/13/1/203
- https://www.rhimagnesitaindia.com/blog/major-types-of-refractories,-characteristics,-and-their-applications-/26
- https://tameson.com/pages/lubricants
- https://www.toppr.com/guides/geography/mineral-and-energy-resources/composite-materials-definition-and-its-types/

24BY101
Biology for Engineers

Course Category:	**Basic Sciences**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:	**-**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

The course introduces engineering students to key concepts in biology essential for understanding biological systems and their integration into engineering practices. It covers a wide range of topics from basic biological principles to advanced applications in biomedical engineering, bio materials, synthetic biology, and bioinformatics.

Course Objectives:

1. Introduce engineers to foundational concepts in biology essential for understanding biological systems and their relevance to engineering applications.
2. Explore the properties and behavior of biomaterials and biomechanics principles that influence the design and functionality of biomedical devices.
3. Investigate bio-inspired design principles, synthetic biology techniques, and biotechnological applications for engineering innovation.
4. Explore bioinformatics tools and systems biology approaches to analyse complex biological data and understand biological systems at a molecular and cellular level.
5. Investigate advanced topics in biological engineering, such as Nano biotechnology, regenerative medicine, or emerging biotechnologies, to expand students' knowledge and skills.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	demonstrate a fundamental understanding of basic biological principles, such as cell biology, genetics, and physiology, and their application in engineering contexts.	K3
CO2	analyse and evaluate biomaterials based on their mechanical properties and design biomedical devices using biomechanical principles.	K4
CO3	apply bio-inspired design principles and synthetic biology techniques to propose innovative engineering solutions and understand their practical applications in biotechnology.	K3
CO4	develop proficiency in using bioinformatics tools, constructing computational models, and applying systems biology approaches to study and interpret biological data and systems.	K3
CO5	critically analyse and evaluate current research trends and innovations in advanced areas of biological engineering, demonstrating the ability to apply advanced concepts in real-world engineering scenarios.	K4

Course articulation matrix

COs	POs										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	-	-	-	-	-	-
CO2	-	2	1	3	-	-	-	-	-	-	-
CO3	-	-	2	-	3	-	-	-	-	-	-
CO4	-	-	2	3	-	-	-	-	-	-	-
CO5	-	3	-	-	-	2	-	-	-	-	-

(1-Low, 2 -Medium, 3–High) (WK1)

Course Content

Unit-I (9 Hours)
Introduction to Biology for Engineers

- Overview of interdisciplinary nature and importance of biology for engineers
- Basic biological concepts relevant to engineering applications
- Introduction to engineering challenges addressed by biology-inspired solutions
- Introduction to the structure and functions of Biomolecules

Unit-II (9 Hours)
Biomaterials and Biomechanics

- Properties and applications of biomaterials in engineering (e.g., tissue engineering, drug delivery systems)
- Biomechanical principles applied to engineering (e.g., mechanics of bones and joints, biomechanics of tissues)
- Case studies: Design and development of biomaterials for medical implants, prosthetics, and tissue engineering

Unit-III (9 Hours)
Bio inspired Design, Synthetic Biology and Biotechnology

- Introduction to bioinspired design, biomimicry, synthetic biology and genetic engineering (Genetically modified Crops & Animals)
- Examples of biological systems inspiring engineering innovations (e.g., bird flight, gecko adhesion, shark skin, human eye camera)
- Applications of biotechnology in engineering (e.g., bioprocessing, bioremediation, biosensors)

- Case studies: Biomimetic design in robotics, materials science, architecture, Development of biofuels, bioplastics, and biopharmaceuticals

Unit-IV (9 Hours)
Bioinformatics and Systems Biology

- Introduction to bioinformatics tools and databases
- Engineering applications of bioinformatics (e.g., genome sequencing, protein structure prediction, drug discovery)
- Systems biology approaches to understanding complex biological systems and networks
- Case studies: Computational modelling of biological systems, personalized medicine, and synthetic biology

Unit-V (9 Hours)
Advanced Topics in Biology for Engineers

- Emerging trends and cutting-edge research in biology for engineers
- Advanced applications and case studies in specific engineering fields (e.g., nanotechnology, energy, environmental engineering)
- Ethical considerations (Bio-Safety) and societal implications (Biopiracy & Bio patent)

Text Books:

1. Johnson, A. T. (2011). Biology for Engineers. CRC Press.
2. Renneberg, R. (2017). Biotechnology for Engineers: Biological Processes and Technologies (1st ed.). Elsevier.
3. Mount, D. W. (2004). Bioinformatics: Sequence and Genome Analysis (2nd ed.). Cold Spring Harbor Laboratory Press.

Reference Books:

1. Enderle, J., & Bronzino, J. (2011). Introduction to Biomedical Engineering (3rd ed.). Academic Press.
2. Ratner, B. D., Hoffman, A. S., Schoen, F. J., & Lemons, J. E. (2012). Biomaterials Science: An Introduction to Materials in Medicine (3rd ed.). Academic Press.
3. Benyus, J. M. (2002). Biomimicry: Innovation Inspired by Nature. Harper Perennial.

Web Resources:

1: Introduction to Biology for Engineers (https://archive.org/details/biologyforengine0000john)

2: The Interdisciplinary Role of Biology in Engineering (https://onlinecourses.nptel.ac.in/)
3: Biomaterials in Engineering (https://link.springer.com/book/10.1007/978-3-031-35832-6)
4:Biomechanics Principles (https://www.cambridge.org/core/books/introductory biomechanics/79733231375F00B75C84A47CCABB9386)
5: Bioinspired Design (https://link.springer.com/article/10.1007/s00163-020 00333-w)
6:BiomimicryApplications(https://www.cambridge.org/core/books/abs/bioinspired-structures-and design/bioinspired-and-biomimetic-design-of-multilayered-and-multiscale structures/D14F3C8BD06061B5983B7DAB55D6B1FA)
7: Fundamentals of Synthetic Biology (https://www.nature.com/subjects/synthetic-biology) Resource 8: Biotechnology Applications (https://open.umn.edu/opentextbooks/textbooks/820)
8: Bioinformatics Tools and Databases (https://microbenotes.com/bioinformatics-databases-software-tools/)
9: Systems Biology Approaches (https://link.springer.com/protocol/10.1007/978-981-99-6913-5_9)
10: Emerging Trends in Bioengineering (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7392392/)
11: Advanced Applications in Bioengineering (https://ibecbarcelona.eu/about-us/applications-in-bioengineering/)
12: Ethical Considerations in Biotechnology (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6612373/)

COURSE CODE: 24CS102
PROGRAMMING USING C

Course Category:	Engineering Science (ES)	**Credits:**	3
Course Type:	Theory	**Lecture -Tutorial-Practice:**	3-0-0
Pre-requisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	40 60 100

Course Description

This course introduces foundational programming concepts, covering algorithms, flowcharts, and pseudo code. It explores the C language structure, data types, operators, control structures, loops, arrays, strings, and functions. Advanced topics include pointers, dynamic memory allocation, structures, unions, enumerations, and file handling. Students gain hands-on experience with inter-function communication, recursion, sorting/searching techniques, and memory management. The course emphasizes practical coding skills, problem-solving, and program design, providing a solid foundation for software development using the C language.

Course Objectives

- *To introduce students to the fundamentals of computer programming.*
- *To provide hands-on experience with coding and debugging.*
- *To foster logical thinking and problem-solving skills using programming.*
- *To familiarize students with programming concepts such as data types, control structures, functions, and arrays.*
- *To encourage collaborative learning and teamwork in coding projects.*
- *To evaluate and apply C programming techniques proficiently for searching and sorting.*

Course Outcomes

At the end of the course, the student will be able to

	Course Outcomes	BTL	POI
CO1	Understand fundamental programming concepts in C through algorithms, flowcharts, and selection statements.	**K2**	1.7.1,2.5.1, 2.5.2, 2.7.1
CO2	Develop efficient C programs using loops, arrays, and strings using control structures.	**K3**	1.7.1,2.5.1, 2.5.2, 2.6.3,3.5.1
CO3	Implement modular C programs using functions, pointers, and memory optimizations.	**K3**	1.7.1, 2.5.2, 2.6.3, 3.5.1, 5.4.1
CO4	Develop C programs using structures and unions for user defined data types.	**K3**	2.5.2, 2.6.3,3.5.1
CO5	Analyze the use of enumerations and file handling techniques in C to manage data efficiently and solve real-world programming problems.	**K4**	1.7.1,2.5.1, 2.5.2, 2.6.3,3.5.1

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	3	2											
CO2	3	3	2									2	2
CO3	2	2	2		2							2	2
CO4	2	2	2									2	2
CO5	2	2	2									2	2

(1- Low, 2 - Medium, 3 – High)

Unit-I : Introduction to C & Problem solving (9 Hours)

Introduction to the C Language: Introduction to Programming Languages, Basics of a Computer Program, Algorithms, flowcharts (Using Dia Tool), pseudo code. Introduction to Compilation and Execution, Background of C program, Identifiers, Types, Variables, Constants, Memory Layout, Input/Output, Programming Examples.

Structure of a C Program: Logical Data and Operators, Expressions, Precedence and Associatively, Evaluating Expressions, Type Conversion, Statements, Storage Class.

Selection: Two-way Selection, Multiway selection, More Standard Functions.

Unit-II: Repetition, Arrays & Strings (9 Hours)

Repetition: Concept of Loops in C, Loop Examples, the Calculator Program.

Arrays: Array Concepts in C, Inter-Function Communication, Array Applications, One Dimensional Arrays, Linear Search and Binary Search Techniques, Selection Sort, Bubble Sort, Two Dimensional Arrays, Multidimensional Arrays.

Strings: String Concepts, C Strings, String Input/output Functions, Arrays of Strings, String Manipulation Functions, String- Data Conversion.

Unit-III: Functions, Pointers & Memory Allocations (9 Hours)

Functions: Functions in C, User Defined Functions, Call by Value, Call Value Reference, Inter-Function Communication, Standard Functions, Scope, Recursion and advantages.

Pointers: Introduction to Pointers, Pointers for Inter-Function Communications, Pointers to Pointers, Compatibility, Lvalue and Rvlaue. Arrays and Pointers, Pointers Arithmetic and Arrays, Passing an Array to a Function, Array of Pointers.

Memory Allocation: Need of dynamic memory allocation, malloc(), calloc(), free(), realloc(), NULL, Stack vs. Heap Allocation.

Unit-IV: Structures & Unions (9 Hours)

Structures: Structure Type Declaration, Initialization, Accessing Structures, Operations on Structures, Complex Structures, Structures and Functions, Sending the Whole Structure, Passing individual structure members, passing structure via pointer, nested structure.

Unions: Referencing Unions, Initializers, Unions and Structures, Internet Address, Programming Applications.

Unit-V: Enumerations & Files (9 Hours)

Enumerations: The Type Definition (Typedef), Enumerated Types: Declaring an Enumerated Type, Operations on Enumerated Types, Enumeration Type Conversion, Initializing Enumerated Constants, Anonymous Enumeration: Constants, Input/Output Operators.

Files: introduction to the files, Uses of Files, Text files Vs. Binary files, Opening and closing FILE , Modes of FILE operation, Command line arguments, Standard Library Input /Output functions ,Character i/o functions, File Handling functions.

Text Books:

1. "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice-Hall, 1988
2. Behrouz A. Forouzan and Richard F. Gilberg, “Computer Science A Structured Programming Approach Using C”, CENGAGE Learning, Third Edition.
3. Schaum’s Outline of Programming with C, Byron S Gottfried, McGraw-Hill Education, 1996

Reference Books:

1. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education, 2008.
2. Programming in C, Rema Theraja, Oxford, 2016, 2nd edition
3. C Programming, A Problem Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE, 3rd edition
4. Horowitz Sahni and Anderson-Freed, “Fundamentals of Data Structures in C”, 2nd edition, Universities Press, 2011

Web Resources:

1. NPTEL, "NOC: Introduction to Programming in C," [Online]. Available: https://nptel.ac.in/courses/106/104/106104128/. [Accessed: Feb. 25, 2025].
2. Coursera, "C for Everyone: Structured Programming," [Online]. Available: https://www.coursera.org/learn/c-structured-programming/. [Accessed: Feb. 25, 2025].
3. GeeksforGeeks, "Arrays, Pointers and Functions in C," [Online]. Available: https://www.geeksforgeeks.org/arrays-and-pointers-functions-in-c/. [Accessed: Feb. 25, 2025].
4. GeeksforGeeks, "C Enumerations," [Online]. Available: https://www.geeksforgeeks.org/enumeration-enum-c/. [Accessed: Feb. 25, 2025].

5. Codeforwin, "Understanding malloc, calloc, realloc, and free," [Online]. Available: https://codeforwin.org/2018/07/malloc-calloc-realloc-free-functions-c-programming.html. [Accessed: Feb. 25, 2025].
6. GeeksforGeeks, "Unions in C," [Online]. Available: https://www.geeksforgeeks.org/union-c/. [Accessed: Feb. 25, 2025].
7. Programiz, "Structures in C," [Online]. Available: https://www.programiz.com/c-programming/c-structures. [Accessed: Feb. 25, 2025].
8. TutorialsPoint, "Formatting Input/Output Functions and Character Input/Output Functions," [Online]. Available: https://www.tutorialspoint.com/cprogramming/c_file_io.htm. [Accessed: Feb. 25, 2025].
9. Programiz, "Command-Line Arguments," [Online]. Available: https://www.programiz.com/c-programming/c-command-line-arguments. [Accessed: Feb. 25, 2025].
10. W3Schools, "C Programming Language," [Online]. Available: https://www.w3schools.com/c/index.php. [Accessed: Feb. 25, 2025].

COURSE CODE: 24CS181
PROGRAMMING USING 'C' LAB

Course Category:	Engineering Science (ES)	**Credits:**	1.5
Course Type:	Practical	**Lecture -Tutorial-Practice:**	0-0-3
Pre-requisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	60 40 100

Course Description

This hands-on course introduces students to the foundational principles of the C programming language, integrating essential Linux command-line skills and compiler tools such as GCC and Turbo C. The course emphasizes problem-solving, logical thinking, and algorithm development. Students will work through a structured progression from simple input/output to complex file operations and data structures, including practical projects and assignments.

Course Objectives

The primary objective of this C Programming Lab course is to provide hands-on practical experience in writing, debugging, and executing C programs. It aims to develop students' understanding of fundamental programming concepts such as input/output operations, control structures, arrays, strings, functions, and pointers through practical exercises. By the end of the course, students will be proficient in using essential C programming tools, developing logical problem-solving skills, and applying programming concepts to build efficient programs in a Linux environment using compilers like Turbo C and GCC.

Course Outcomes

At the end of the course, the student will be able to

	Course Outcomes	BTL	POI
CO1	Understand basic Linux shell commands to compile and run C programs using GCC.	**K2**	1.7.1,2.5.1, 2.5.2, 2.7.1
CO2	Select the right control structure for solving the problem.	**K3**	1.7.1, 2.5.1,2.5.2, 2.6.3,3.5.1
CO3	Develop C programs which utilize memory efficiently using programming constructs like pointers.	**K3**	1.7.1, 2.5.2, 2.6.3,3.5.1 5.4.1
CO4	Develop, Debug and Execute programs to demonstrate the applications of arrays, functions, basic concepts of pointers in C.	**K3**	2.5.2, 2.6.3,3.5.1
CO5	Analyze the use of enumerations and file handling techniques in C to manage data efficiently and solve real-world programming problems.	**K4**	1.7.1, 2.5.1,2.5.2, 2.6.3,3.5.1

Contribution of Course Outcomes towards achievement of Program Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2
CO1	2	2											
CO2	3	2	3									2	2
CO3	3	2	3		2							2	2
CO4	3	2	3									2	2
CO5	2	3	3									2	2

(1- Low, 2 - Medium, 3 – High)

Course Content:

WEEK- 1

1. Basic Linux environment and its editors like Vi, Vim & Emacs etc.

2. Exposure to Turbo C, gcc

3. Write a C program to print the following output Input:

```
Enter a Character: *
Enter a Number: 1
Output:
* * * * * * *
*       1     *
*       1     *
*       1     *
*       1     *
*     1 1 1   *
* * * * * * *
```

4. Write a C program that takes two numbers and an arithmetic operator (+, -, *, or /) as input from the user using scanf(), performs the corresponding operation, and displays the result using printf().

5. Write a C program that reads two numbers from the user using `scanf()`, and then swaps their values using both methods:

1. With a third variable 2.Without using a third variable

Finally, display the swapped values using `printf()`.

.

6. Declare three variables of integer data type. User has to input three valid numbers. Display Sum and average of user entered numbers.
Approach is to take three numbers and find their sum and average using the formula given below-

Sum: a+b+c
Average: (a+b+c)/3
Where a,b,c are the three numbers.
Sample Input:
Enter 3 Values: 10 20 30
Sample Output: Sum: 60 Average: 20

WEEK-2

1. Input the temperature in Fahrenheit and output the equivalent temperature in Celsius and Vice – Versa. Input two numbers. The first is for a Celsius value, and the second is for a Fahrenheit value. Input Celsius value, convert it to Fahrenheit. Use the formula F = C*9/5 + 32 for conversion. In case of decimals, show up to 1 decimal value.
Input the Fahrenheit value, convert it to Celsius.
Use the formula C= (F−32)×5/9 for conversion. In case of decimals, show up to 1 decimal value.
Sample Input: 0 100
Sample Output: 32 37.7

2. You can calculate a Simple Interest by just providing the Principle Amount, Rate of Interest and Time or Periods provided by the user input. We can calculate the Simple Interest by the using the below Formula.

Simple Interest = (Principal*Rate*Time)/100

Principal (P): The principal is the amount that was initially borrowed (loan) from the bank or invested.

Rate (R): It is the rate of interest at which the principal amount is given to someone for a certain time; the rate of interest can be 5%, 10%, or 13%, etc.

Time (T): Time is the duration for which the principal amount is given to someone.

Constraints: 1<=Principal<=10000 1<=Rate<=10
1<=T<=30
Sample Input: 100 3 10
Sample Output: 30

3. You are working on a program that tracks the daily sales of a small bookstore. The owner wants to calculate the total sales and average sales for three consecutive days to better understand business trends. Write a program that takes the sales figures for three days as input, calculates the total sales, and finds the average sales. How will you implement this in C?

4. Write a C program to evaluate and display the result of the following expressions. Use the given variable declarations and initialize them with appropriate values. Also, print the results of each expression.

- A+B*C+(D*E) + F*G
- A/B*C-B+A*D/3
- A+++B---A
- J= (i++) + (++i)

5. Write a C program to calculate electricity bill according to the given condition:

For first 50 units Rs. 0.50/unit

For next 100 units Rs. 0.75/unit

For next 200 units Rs. 1.20/unit

For unit above 250 Rs. 1.50/unit

An additional surcharge of 20% is added to the bill.

WEEK- 3

1. To find factorial of the any given positive number. The factorial of a positive number n is given by: 1*2*3*4 ...Note: This program should take a positive integer from the user as the factorial of a negative number doesn't exist and, the factorial of 0 is 1. Compute the factorial using any loop. Since the factorial of a number
may be very large, the type of factorial variable is declared as unsigned long. If the user enters a negative number, the program should display a custom error message.

2. Input a number, check the given number is a prime or not. A prime number should be a natural number greater
than 1 that has no positive divisors other than 1 and itself.
Test Data and Output: Enter n: 5
Output: Prime
Enter n: 6
Output: Not Prime

3. Checking a number palindrome. Number should be a positive integer having more than one digit as all the single digits are palindromes.
Test Data and output:
Input : 2002 Input: 1234
Output: true Output: false

4. Construct a pyramid of numbers. A pyramid of numbers represents the number of individuals per unit area of various trophic areas where producers are kept at the base and the tip is occupied by top carnivores.

The pyramid of numbers is mostly upright. The members of successive higher trophic levels are higher than the previous one.

1. A higher trophic level has fewer individuals than that of the lower trophic levels.

1

2 2 2

3 3 3 3 3

4 4 4 4 4 4 4

5 5 5 5 5 5 5 5 5

5. Develop a C program that takes an integer as input from the user and prints 'Yes' if the number is an Armstrong number, and 'No' otherwise.(This adds specific input/output requirements.)

WEEK- 4

1. Write a C program to delete all duplicate elements from an array.
The program should:

- Ask the user to enter the number of elements in the array.
- Accept the array elements from the user.
- Remove all duplicate values from the array.
- Display the new array with only unique elements.

2. Write a C program to insert an element into a specific position in an array.
The program should:

- Ask the user to enter the size of the array and its elements.
- Ask the user to enter the element to insert and the position at which it should be inserted.
- Insert the element at the specified position by shifting the existing elements.
- Display the updated array.

3. Find 2's complement of the given binary number.
To get 2's complement of a binary number, simply invert the given number and add 1 to the least significant bit (LSB) of given result.
Test Data and Output:
Find 2's complement of binary number 10101110.
Simply invert each bit of given binary number, which will be 01010001. Then add 1 to the LSB of this result, i.e., 01010001+1=01010010 which is answer.
Find 2's complement of binary number 10001.001.
Simply invert each bit of given binary number, which will be 01110.110 Then add 1 to the LSB of this result, i.e., 01110.110+1=01110.111 which is answer.

4. Write a C program to sort array elements in ascending or descending order.

5. Given an array of integers **nums** and an integer **target,** return indices of the two numbers such that they add up to target. You may assume that each input would have exactly one solution and you may not use the same element twice. You can return the answer in any order.
Sample Input:
Enter the size of an array: 4
Enter array elements: 2 7 11 15
Enter target: 9
Output: [0,1]

WEEK- 5

1. A matrix can only be added to another matrix if the two matrices have the same dimensions. To add two matrices, just add the corresponding entries, and place this sum in the corresponding position in the matrix which results.
Input elements in 3x3 matrix1: 1 2 3
4 5 6
7 8 9
Input elements in 3x3 matrix2: 9 8 7
6 5 4
3 2 1
Sum of both matrix = 10 10 10
10 10 10
10 10 10

2. Matrix multiplication is a binary operation that produces a matrix from two matrices. For matrix multiplication, the number of columns in the first matrix must be equal to the number of rows in the second matrix. The resulting matrix, known as the **matrix product**, has the number of rows of the first and the number of columns of the second matrix. The product of matrices **A** and **B** is denoted as AB.

3. Concatenate two strings without using built-in functions
Note: User would be asked to enter two strings and then the program would concatenate them. For concatenation we have not used the standard library function strcat(), instead we have written a logic to append the second string at the end of first string.
Test Data and Output:
Str1: Good Str2: Morning Output: Good Morning

4. Reverse a string using built-in and without built-in string functions
Using built-in function: The function is used for reversing a string. The reversed string will be stored in the same string.

5. Input two strings **str1** in lowercase**, str2** in uppercase**.** Print the lower case string **str1** in uppercase and the uppercase string **str2** in lowercase.

WEEK- 6

1. Write a C program using a user-defined function to find the biggest number given any three numbers.

2. Write a **C program** to calculate the **factorial of a given number** using recursion. The program should prompt the user to enter a number and then compute its factorial using a recursive function.

3. Write a **C program** to generate the **Fibonacci series up to N terms** using a recursive function. The program should prompt the user to enter a number **N**, then compute and display the first **N Fibonacci numbers**.

4. Write a **C program** to swap two numbers using **call by value and call by reference**. The program should demonstrate that changes made inside the function do not affect the original values in the main function.

5. How can recursion be used to calculate NCR? Write a C program to demonstrate this.

WEEK- 7

1. String is a sequence of characters. Input two strings str1 and str2. Copy the contents of str1 to str2 using functions and pointers. Define a function copystr() with two pointer arguments copystr(*str1,*str2) Approach :
1. Scan string str from 0 to length-1.
2. check one character at a time based on ASCII values
- if(str[i] >= 65 and str[i] <=90), then it is uppercase letter,
- if(str[i] >= 97 and str[i] <=122), then it is lowercase letter,
- if(str[i] >= 48 and str[i] <=57), then it is number,
- else it is a special character

3. Print all the counters
Sample Input:
Enter a string: Programming
Sample Output:
String1: Programming
String2: Programming

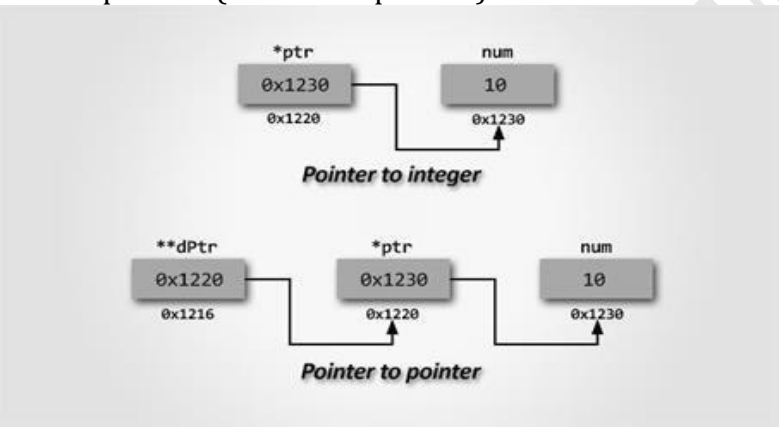
2. Given a string, write a program to count the occurrence of Lowercase characters, Uppercase characters, Special characters, and Numeric values. Define a function to count.
Input : #CseAi01dOr@gAIml07
Output :
Upper case letters : 5
Lower case letters : 8
Numbers : 4
Special Characters : 2
Input : *AiMlC4AiDsS*

Output :
Upper case letters : 6
Lower case letters : 4
Numbers : 1
Special Characters : 2

3. Write a c program to perform simple pointer arithmetic operations in c.

4. Write a c program to find sum of array elements by using array of pointers in c

5. When a pointer holds the address of another pointer then such type of pointer is known as pointer-to-pointer or double pointer. ptr is a normal pointer that holds the address of an integer variable num. There is another pointer **dptr in the diagram that holds the address of another pointer ptr, the pointer dptr here is a pointer-to-pointer (or double pointer). Demonstrate double pointers using the following representation.



WEEK- 8

1. Write a C program to define a structure named Student that contains the following members:

- name (character array)
- rollNumber (integer)
- age (integer)

Using a structures concept, store and display the details of two students.

.

2. Write a C program to define a structure named Student with the following members:

- name (character array) – to store the student's name.
- rollNumber (integer) – to store the roll number.
- marks (array of 3 integers) – to store marks obtained in 3 subjects.

Using an array of structures, read the details of two students from the keyboard. Calculate and display:

- Name of the student
- Roll number
- Marks in 3 subjects
- Total marks obtained

3. Write a C program to define a structure named Book with the following members:

- title (character array) – to store the book's title.
- author (character array) – to store the author's name.
- price (float) – to store the price of the book.

Using an array of structures, read the details of **five books** from the keyboard and display them in a formatted output.

4. Write a C program to define a structure **Student** that includes the following details:

- Name (character array)
- Roll Number (integer)
- Age (integer)
- Date of Birth (another structure with day, month, and year as integers)

Note: Student Details (with Date of Birth as a Nested Structure)

5. Write a C program to define a structure **Employee**, which contains the following details:

- **Employee Name** (character array)
- **Employee ID** (integer)
- **Salary** (float)

Additionally, the structure **Employee** should have a **nested structure Address**, which includes:

- **City** (character array)
- **State** (character array)
- **Pin Code** (integer)

The program should:

- Accept details of an employee, including their address.
- Display the entered details in a proper format.

Write the complete C program, including structure definition, input, and output statements.
Note: Employee Records (with Address as a Nested Structure)

WEEK- 9

1. Write a C program to demonstrate **passing individual structure members** to a function. Define a structure for a student with members: name, roll number, and marks. Pass individual members to a function to display the details.

2. Explain the concept of **passing an entire structure** to a function in C. Write a program to define a structure for an Employee with members: name, ID, and salary. Pass the entire structure to a function to display the details.

3. Define a union Data with members: i (integer), f (float), str (string). Write a program to assign and print values to each member of the union one by one. Observe what happens to the values.

4. Explain the concept of **passing a structure through pointers** in C. Write a program to define a structure for a Student with members: name, roll number, and marks. Pass the address of the structure to a function and display the student details using pointers.

5. Write a C program to **add two complex numbers**.

- Define a **structure** Complex with two members: real (to store the real part)
- imag (to store the imaginary part)
- Take input for two complex numbers from the user.

Perform the addition of the two complex numbers: Add the **real parts** separately.

- Add the **imaginary parts** separately.
- Display the **sum** of the two complex numbers in the form **(a + bi)**.

Sample output:
Enter first complex number: 3 2
Enter second complex number: 1 7
Sum: 4 + 9i

WEEK- 10

1. Write a C program that defines an enumeration for different car brands and asks the user to enter a number. Display the corresponding car brand.

2. Create an enum for traffic signals (Red, Yellow, Green). Write a function that takes an enum value as input and prints its meaning (e.g., Red → Stop).

3. Write a C program to store and process student data using dynamic memory allocation with calloc(). The program should:

- Allow the user to enter the number of students (n).
- Dynamically allocate memory for n students using calloc().
- For each student, input details such as **roll number, name, and marks**.
- Display the list of students who have **failed** (consider marks less than 40 as failed).

4. Write a C program to print the corresponding weekday name for a given integer value (1 to 7) using enumeration constants. The program should define an enum for the weekdays, take an integer input from the user, and display the corresponding weekday name. If the input is out of range, display an appropriate error message.

5. Write a C program to write and read text into a file.The program should prompt the user to enter a string and write it to a text file. Then, it should open the same file, read the content, and display it on the screen.

6. Write a C program to copy the contents of one file to another using command-line arguments. The program should accept the source filename and the destination filename as command-line arguments. It should read the contents from the source file and write them to the destination file. If the source file does not exist or an error occurs, display an appropriate error message.

Web Resources:

1. LinuxCommand.org, "Basic Linux Environment, Editors, Turbo C, GCC," [Online]. Available: https://linuxcommand.org/. [Accessed: Feb. 25, 2025].
2. Programiz, "Pattern Printing & Block Letters in C," [Online]. Available: https://www.programiz.com/c-programming/examples/pattern-printing. [Accessed: Feb. 25, 2025].
3. GeeksforGeeks, "Arithmetic Operations & Swapping Numbers," [Online]. Available: https://www.geeksforgeeks.org/swap-two-numbers-without-using-temporary-variable/. [Accessed: Feb. 25, 2025].
4. CodingCompiler, "Sum and Average of Numbers," [Online]. Available: https://codingcompiler.com/c-program-find-sum-average-three-numbers/. [Accessed: Feb. 25, 2025].
5. TutorialsPoint, "Reading and Printing Multiple Integers," [Online]. Available: https://www.tutorialspoint.com/cprogramming/c_arrays.htm. [Accessed: Feb. 25, 2025].
6. Programiz, "Mixed Data Types Input & Format Specifiers," [Online]. Available: https://www.programiz.com/c-programming/c-input-output. [Accessed: Feb. 25, 2025].
7. GeeksforGeeks, "Files in C," [Online]. Available: https://www.geeksforgeeks.org/basics-file-handling-c/. [Accessed: Feb. 25, 2025].

24ME181
ENGINEERING GRAPHICS

Course Category:	Engineering Sciences (ES)	**Credits:**	**2.5**
Course Type:	Tutorial & Practice	**Lecture-Tutorial-Practice:**	**0-1-3**
Pre-requisites:	**Nil**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**60** **40** **100**

Course Description:

This course introduces students to the principles and practices of engineering graphics using Computer- Aided Design (CAD) tools. This course covers Plane and Descriptive geometry, orthographic and isometric projections. Students will learn to create, modify, and analyze 2D and 3D drawings, focusing on applications in engineering.

Course Objectives:

- To familiarize students with CAD software and its application in technical drawing.
- To make students proficient in creating and editing 2D and 3D engineering drawings.
- To teach the drawing of plane curves and their applications
- To explain the projection of points, lines, Planes, and solids.
- To enable students to visualize and represent 3D objects through orthographic projections, isometric views and development of surfaces.
- To cultivate skills in preparing engineering drawings following standard conventions and practices.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Construct plane curves and identify their applications.	K3
CO2	Draw orthographic projections of points, lines and planes	K3
CO3	Develop 2D drawings of solids and surfaces.	K3
CO4	Demonstrate proficiency in creating isometric projections.	K4
CO5	Identify the 3D objects through orthographic projections.	K4

Course articulation matrix

	POs											PSOs	
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2		2		2				2				1
CO2	2		2		2				2				1
CO3	2		2		2				2				1
CO4	2		2		2				2				1
CO5	2		2		2				2				1

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (3 Tutorials +9 Practice)

Plane Curves

- Construction of **Ellipse, Parabola and Hyperbola** (General method only)
- Construction of **cycloids & Involutes.**

Unit-II (3 Tutorials +9 Practice)

Orthographic Projections:

- Projections of **Points.**
- Projections of **Lines** (First Angle Projection only)
- Projections of **Plane regular geometric figures**. (First Angle Projection only)

Unit-III (3 Tutorials +9 Practice)

Projection of Solids and Development of Surfaces

- Projections of simple solids such as Cubes, Prisms, Pyramids, Cylinders and Cones with varying positions (Limited to Solid Inclined to one of the Reference planes)
- Development of surfaces of Right Regular Solids of Prism, Pyramid, Cylinder and Cone.

Unit-IV **(3 Tutorials +9 Practice)**

Conversion to orthographic Projection

- Orthographic projection conventions.
- Conversion of Isometric views into orthographic projections

Unit-V (3 Tutorials +9 Practice)

Conversion to Isometric Projection

- Isometric Projection Principles, Isometric Views of Objects.
- Conversion of Orthographic Projections into Isometric Views

Text Books:

1. Kulkarni, D. M., Rastogi, A. P., & Sarkar, A. K. (2009). Engineering graphics with AutoCAD, (revised ed.). PHI Learning Pvt. Ltd.

2. N.D. Bhatt "Engineering Drawing", Charotar Publishing House, Anand. 53rd Edition – 2019.

Reference Books:

1. Bethine. A. Fishel, Jay D. Helsel, (2014). Engineering Graphics with AutoCAD, Pearson Education.
2. CADFolks, (2023). AutoCAD 2023 for Beginners, CAD Folks Publications.
3. BasanthAgrawal& C M Agrawal," Engineering Drawing", McGraw Hill Education Private Limited, New Delhi.

Web Resources:

[1] **https://www.onlinecourses.nptel.ac.in/noc20_me79/preview**
[2] https://www.autodesk.com/education
[3] https://www.freecad.org
[4] https://ocw.mit.edu/

24CY181
Chemistry Lab

Course Category:	**Basic Sciences**	**Credits:**	**1**
Course Type:	**Practical**	**Lecture-Tutorial-Practice:**	**0-0-2**
Pre-requisites:	**10+2 Chemistry**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**60** **40** **100**

Course Description:

The course is designed for students of B.Tech., providing essential practical knowledge of Chemistry concepts relevant to their fields. This hands-on laboratory course provides the students with practical experience in applied chemical techniques and experiments. The course is useful for students to develop essential skills of proper handling of instruments and apparatus, accurate measurements and recording data, as well as interpretation of data to arrive at the correct conclusion. The course includes the experiments based on different instrumental techniques for the quantitative analysis of different solutions. Also, the course enlightens the students on preparation of polymers, and corrosion related experiments. Further, it focuses on the conventional method of quantitative determination of samples using volumetric method.

Course Objectives:

1. Enhance understanding of chemical principles involved in instrumental methods of chemical analysis.
2. Develop skills in handling analytical instruments that can measure various chemical parameters.
3. Promote critical thinking and problem-solving through the interpretation of data obtained from the instruments.
4. Familiarize students with advantages and limitations of instrumental methods of analysis compared to conventional volumetric analysis.
5. Explore the practical aspects of chemical processes involved in preparation of polymers, metallic coatings, etc.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Demonstrate a comprehensive understanding of various instrumental methods of chemical analysis	**K3**
CO2	Analyse quantitatively different redox systems and neutralization systems using volumetric analysis	**K4**
CO3	Compare corrosion tendencies of different metals and their protection by surface coatings	**K4**

CO4	Apply theoretical knowledge and skills of preparation of polymers, complexes on substrates, adsorption processes, porosity, viscosity, etc.	**K3**

Course articulation matrix

	POs										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	2	3	-		1	-	-	-	-	-	-
CO2	2	3	-	1		-	-	-	-	-	-
CO3	2	3	-		1	-	-	-	-	-	-
CO4	2	3	-	1		-	-	-	-	-	-
CO5	2	3	-		1	-	-	-	-	-	-

(1-Low, 2 -Medium, 3–High) (WK1)

Course Content

Experiments common to all branches:

1. Determination of strength of acid in a lead-acid battery
2. Determination of strength of base using pH metric titration
3. Conductometric analysis of a base using a standard acid
4. Determination of ferrous iron by permanganometry
5. Comparison of corrosion rates of different metals/alloys
6. Preparation of Urea-formaldehyde resin
7. Determination of amount of iron in a solution by colorimetry
8. Chemistry of blueprinting
9. Adsorption of acetic acid on charcoal

Experiments for CE and ME branches:

1. Determination of total hardness of a water sample
2. Determination of calcium in Portland cement
3. Determination of porosity of a refractory material
4. Determination of viscosity of lubricating oil by Redwood viscometer

Experiments for ECE, EEE and EIE branches:

10. Determination of ferrous iron by dichrometry
11. Determination of ferrous iron by potentiometry
12. Verification of Lambert-Beer's law
13. Electroplating of copper on iron article

Experiments for CSE, AI and IT branches:

10. Determination of ferrous iron by dichrometry
11. Determination of ferrous iron by potentiometry
12. Conductometric analysis of mixture of acids
13. Preparation of conducting polyaniline from aniline

Text Books:

1. Mendham, J. (2009). *Vogel's Quantitative Chemical Analysis* (6th ed.). Pearson Education.
2. Theodore, J., & George Pope, F. (2021). *Elementary Practical Chemistry. Inorganic and Organic*(1st ed.). Legare Street Press.

Reference Books:

1. Akhil, N., Deepak, L., Atul, B.,&Chaudari, P.B. (2023).*Practical Manual of Inorganic, Organic and Medicinal Chemistry* (1st ed.). IP Innovative.
2. Venkateswaran, V.(2012). *Basic Principles of Practical Chemistry* (2nd ed.). S. Chand& Sons.

Web Resources:

1. https://nitm.ac.in/ckfinder/userfiles/files/CY%20151_Labmanual%20Chemistry%20B_Tech%201st%20year.pdf
2. http://icv-au.vlabs.ac.in/inorganic-chemistry/Water_Analysis_Determination_of_Physical_Parameters/
3. http://pcv-au.vlabs.ac.in/physical-chemistry/EMF_Measurement/
4. http://pcv-au.vlabs.ac.in/physical-chemistry/Determination_of_Viscosity_of_Organic_Solvents/
5. http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/Environmental_Engineering_1/experiments/determination-of-chloride-nitk/simulation.html
6. https://chemcollective.org/vlabs

24ME182
WORKSHOP PRACTICE
(ME)

Course Category:	Engineering Science (ES)	**Credits:**	**1.5**
Course Type:	**Laboratory**	**Lecture-Tutorial-Practice:**	**0-0-3**
Pre-requisites:	**10+2 Physics**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**60** **40** **100**

Course Description: (Part-A)

This part of the course provides first-year engineering students with comprehensive hands-on experience in electrical systems, electronics, and computer science fundamentals. The course covers practical exercises in electrical wiring and circuit design, electronics component handling, and computer hardware and software configuration. Students will engage in activities such as electrical switching circuits, distribution board assembly, electronic component identification, and basic IoT (Internet of Things) projects. The course is designed to equip students with essential skills for diagnosing and constructing electrical and electronic systems, as well as understanding computer hardware and IoT applications.

Course Description: (Part-B)

This part of workshop practice course provides first-year mechanical engineering students with hands-on experience across multiple fundamental areas of engineering, including carpentry, welding, and mechanical components. The course is designed to develop practical skills and technical proficiency through targeted exercises in woodworking, metalworking, and mechanical assembly. Students will gain familiarity with essential tools and techniques, including woodworking tools and joinery, welding processes, and mechanical component handling. By engaging in these practical exercises, students will enhance their ability to apply theoretical concepts in real-world scenarios, laying a strong foundation for advanced engineering studies.

Course Objectives:

1. Understand the fundamentals of house wiring.
2. Familiarize with the various electronic components and PCB preparation
3. Apply the concepts of internet of things (IOT)
4. Familiarize with the modern manufacturing methods.
5. Understand the basic joints using wood and practice joining of metals using various types of welding and familiarize with various mechanical components such as gears,

Nuts and bolts.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
	PART -A	
CO1	Design, assemble, and test various electrical circuits, including stair case, two-way, and fan connections, and accurately measure electrical parameters such as voltage, current, power, and energy using digital meters.	**K3**
CO2	Identify and use electronic components (resistors, capacitors, diodes, switches) to construct and test a simple calling bell circuit, demonstrating understanding of circuit design and component functionality.	**K3**
CO3	Install and configure peripheral devices on a desktop system and apply basic IoT principles using an Arduino board to measure and interpret environmental data such as temperature, humidity, and distance.	**K3**
	PART -B	
CO4	Effectively use woodworking hand and power tools, and apply joinery techniques such as cross half lap and dovetail joints to produce precise and durable wood assemblies.	**K3**
CO5	Proficiently perform arc welding on lap, butt, and corner joints, as well as gas welding processes, while producing high-quality welds with proper safety and technique; additionally, carry out bench work operations such as drilling and tapping, and assemble mechanical components including gears, bearings, and springs, demonstrating competency in precision machining and mechanical assembly.	**K3**

Course articulation matrix

COs	POs										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1			**2**		**3**						
CO2			**2**		**3**						
CO3			**2**		**3**						
CO4			**2**		**3**						
CO5			**2**		**3**						

(1-Low, 2 -Medium, 3–High)

Course Content

PART –A

1. **Electrical Workshop Practice Exercises: (3hrs)**
   a) Stair case/Two-way /Gowdown Switching/Fan connection
   b) 3Φ Distribution board with fuse, MCB, two way switches, light indicator, 4 switches, fan regulator
   c) Measurement of voltage, current, power, Energy by using digital meters.

2. **Electronics Workshop Practice Exercises: (1 hr)**
   a) Familiarization of electronic components such as resistors, capacitors, diodes, and switches.
   b) Preparation of a simple calling bell circuit board and testing its operation.

3. **Computer science Workshop Practice Exercises: (2 hrs)**
   a) **Hardware components of a desktop system:** Peripheral Installation: Install and configure peripheral devices such as printers, scanners, and external hard drives.
   b) **Basics of Internet of things (IOT):** Demonstration of different components and pin configuration of Arduino board.
   c) To measure Temperature, humidity and distance using Arduino board.

4. **Modern Manufacturing methods:** Demonstration of 3-D printing process.

PART –B Branch specific (For ME students only)

5. **Carpentry Workshop Practice Exercises: (2 hrs)**
   a) Woodworking Tools Familiarization: Practice to work with woodworking hand tools and operations using power tools.
   b) **Joinery Techniques:** Practice various joinery techniques such as cross half lap and Dove tail joints.
   c) Practice to work with various wood adhesives and fasteners.
6. **Welding workshop practice exercises: (2 hrs)**
   a) Preparation of Lap, Butt & Corner joints using Arc Welding.
   b) Practice of Gas welding process.

7. **Introduction to Mechanical Components & operations: (3hrs)**

a) **Bench Work Techniques:** Practice to work with various materials like metals and plastics.
b) Practice of drilling, tapping, and reaming operations on the above materials.
c) **Mechanical Components:** Practice of assembling lap and butt joints with various types of bolts, nuts, screws and single, double studs.

- Practice to work with various types of mechanical components such as

d) Gears - Bevel, Spur, Helical and Worm.
e) Bearings – Ball, roller, plain, needle and flexure.
f) Springs – Compression, Extension, Conical, Torsion and leaf.

Text Books:

1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published,2019. Workshop Processes, Practices and Materials; Bruce J. Black,

Routledge publishers, 5th Edn. 2015.
2. A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai& Co., 2015 & 2017.

Reference Books:

1. Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, Media Promoters and Publishers, Mumbai. 2007, 14th edition.
2. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.
3. Wiring Estimating, Costing and Contracting; Soni P.M. &Upadhyay P.A.; AtulPrakashan, 2021-22.

Web Resources:

1. https://dsceme.files.wordpress.com/2016/08/workshop-practice-manual-2016-17-1.pdf
2. https://www.protosystech.com/rapid-prototyping.htm
3. https://www.arduino.cc/en/Tutorial/Foundations
4. https://www.tutorialspoint.com/arduino/

24UC183
Sports and Yoga

Course Category:	**Mandatory (MC)**	**Credits:**	**0**
Course Type:	**Practical**	**Lecture-Tutorial-Practice:**	**0-0-3**
Pre-requisites:	**-**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**100** **-** **100**

Course Description:

The course is designed for first year B.Tech. students of all branches. It provides essential and applied knowledge of physical and mental health. Introducing the course is more crucial in the present days, particularly undergraduate students, who require awareness on their physical and mental health. With this focus, the course covers various aspects of physical fitness, wellness and lifestyle, fundamental aspects of anatomy, physiology in physical education, yoga and lifestyle, different types of sports, etc. Although, the basic theoretical aspects of sports and yoga are discussed, major focus will be on the practice of yoga asanas and participation in various sports by the students.

Course Objectives:

1. Make the students understand the importance of sound health and fitness principles as they relate to better health.
2. Expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about yoga, physical education, health and fitness.
3. Create a safe, progressive, methodical and efficient activity-based plan to enhance improvement and minimize risk of injury.
4. Develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Apply the knowledge of physical activities and Hatha Yoga on himself/herself and practice them	**K3**
CO2	Understand basic skills associated with yoga and physical activities including strength, flexibility, balance and coordination	**K2**
CO3	Practice yoga asanas, pranayama and meditation in daily life for the health of body and balance of mind	**K3**
CO4	Apply correctly the biomechanical and physiological principles elated to exercise and training	**K3**

CO5	Practice techniques for increasing concentration and decreasing anxiety which leads to stronger academic performance	**K3**

Course articulation matrix

COs	POs										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	-	-	-	-	-	-	**1**	**2**	-	-	**3**
CO2	-	-	-	-	-	-	**1**	**2**	-	-	**3**
CO3	-	-	-	-	-	-	**1**	**2**	-	-	**3**
CO4	-	-	-	-	-	-	**1**	**2**	-	-	**3**
CO5	-	-	-	-	-	-	**1**	**2**	-	-	**3**

(1-Low, 2 -Medium, 3–High) (WK8)

Course Content

Unit-I (9 Hours)

Introduction to physical education, physical fitness, wellness and life style

- Meaning and definition of physical education, aims and objectives, changing trends in physical education.
- Meaning and importance of physical fitness and wellness, components of physical fitness.
- Components of health related fitness, components of wellness.
- Preventing health threats through lifestyle change and concept of positive lifestyle.
- Awards and honours in the field of sports in India (Dronacharya Award, Arjuna Award, Dhayanchad Award, Rajiv Gandhi Khel Ratna Award, etc.)

Unit-II (9 Hours)

Fundamentals of anatomy, physiology, kinesiology, biomechanics and sports

- Meaning of anatomy, physiology and their importance in the context of physical education and sports.
- Effect of exercise on the functioning of various body systems like circulatory system, respiratory system, neuromuscular system, etc.
- Meaning and importance of kinesiology and biomechanics in physical education and sports, Newton's law of motion and its application in sports, friction and its effects in sports.
- Concept of postures, causes of bad posture, advantages of correct posture, advantages and disadvantages of weight training, common postural deformities – knock knee, flat foot, round shoulders, lordosis, kyphosis, bow legs and scoliosis.

Unit-III (9 Hours)
Psychology in Sports

- Definition and importance of psychology in physical education and sports, differentiation between growth and development.
- Adolescent problems and their management, concept and types of emotions, control of emotions, meaning and types of aggressions in sports, psychological benefits of exercise.
- Anxiety and fear and their effects on sports performance, motivation – types and techniques, understanding stress and coping strategies.
- Concept and meaning of doping, prohibited substances and methods, side effects of prohibited substances.
- First aid – definition and objectives, sports injuries – classification, causes and prevention, management of injuries – soft tissue injuries and bone and joint injuries.

(Following subtopics related to any one game/sport of choice of student out of: Athletics, Badminton, Basketball, Chess, Cricket, Kabaddi, Lawn Tennis, Swimming, Table Tennis, Volleyball, etc.: History of the game/sport, latest general rules of the game/sport, specifications of play fields and related sports equipment, important tournaments and venues, sports personalities, proper sports gear and its importance.)

Unit-IV (9 Hours)
Theoretical aspects of Yoga and practice of Asanas

- Meaning, history and basic concepts of yoga, three bodies of human system, panchakoshas, trigunas, and ashtanga yoga.
- Meaning of asanas, practice of sukshma vyayama (warm up for asanas), asanas as preventive measures, practice of various asanas in the four categories – standing, sitting, prone and supine – at least 5 postures from each category, variations, contraindications and benefits of the asanas, Sun salutations.
- Asanas for hypertension, back pain, diabetes, asthama, obesity, etc.

Unit-V (9 Hours)
Theory and practice of pranayama and meditation

- Meaning of pranayama, instructions for practice of pranayama, practice of various pranayama techniques – abdominal breathing, kapalabhati, anulom-vilom pranayama, bhramari, etc.
- Relaxation techniques for improving concentration – Yognidra
- Meaning of meditation, difference between concentration and meditation, various meditation methods, heartfulness meditation practice, benefits of meditation.

Text Books:

1. Modern trends and physical education – Prof. Ajmer Singh.
2. Light on Yoga – B.K.S. Iyengar.

Reference Books:

1. Health and Physical Education – NCERT (11^{th} and 12^{th} Classes).
2. Light on Pranayama – B.K.S. Iyengar.

Web Resources:

1. https://ncert.nic.in/textbook/pdf/iehp103.pdf
2. https://www.physio-pedia.com/Biomechanics_In_Sport
3. https://en.wikipedia.org/wiki/Sport_psychology
4. https://www.physio-pedia.com/Principles_of_Yoga
5. https://ncert.nic.in/pdf/publication/otherpublications/tiyhwlups1.pdf
6. https://heartfulness.org/global
7. https://www.biharyoga.net/asana-and-pranayama.php

II SEMESTER

24MA102
Mathematics-II
(DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS)
COMMON TO ALL BRANCHES

Course Category:	**Basic Sciences (BS)**	**Credits:**	**4**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-2**
Pre-requisites:	**10+2 Mathematics**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

An overview of the fundamental concepts and methods to solve differential equations, Numerical methods to solve algebraic and transcendental equations, initial, boundary value problems and polynomial estimation using interpolation technique with a focus on the applications in solving engineering problems

Course Objectives:

- Introduce techniques for solving differential equations
- Explain methods to solve algebraic and transcendental equations and estimate function values through interpolation /extrapolation
- Acquaint the knowledge of solving initial and boundary value problems

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Apply suitable approaches to solve first order and first-degree ordinary differential equations with engineering applications	**K3**
CO2	Solve higher order ordinary linear differential equations with engineering applications	**K3**
CO3	Solve the partial differential equations	**K3**
CO4	Use iterative methods for solving algebraic & transcendental equations and compute the functional values by polynomial interpolation	**K3**
CO5	Apply numerical methods to solve initial and boundary value problems	**K3**

Course articulation matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	**2**	**2**			**1**								
CO2	**2**	**2**			**1**								
CO3	**2**	**2**			**1**								
CO4	**2**	**2**			**1**								
CO5	**2**	**2**			**1**								

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (9 Hours)

Differential Equations of First Order[T1]

Linear equations, Bernoulli's equation, Exact equations, Equations reducible to exact equations, Newton's Law of cooling, Law of growth and decay.

Unit-II (9 Hours)

Higher Order Linear Differential Equations with Constant Coefficients [T1]

Definitions, Working procedure to solve the equation, Wronskian, Method of variation of

parameters, Simultaneous linear equations, Electrical circuits.

Unit-III (9 Hours)

Partial Differential Equations **[T1]**

Introduction, Formation of partial differential equations, Solutions of a linear equation of the first order using Lagrange's method, Homogeneous linear partial differential equations with constant coefficients: Working procedure to solve the equation.

Unit-IV (9 Hours)

Numerical Methods and Interpolation[T1]

Root finding methods: Bisection method,Method of Iteration,Newton-Raphson method

Interpolation: Introduction, Finite Differences, relation between the operators, Newton's interpolation formulae: forward and backward differences, Interpolation with unequal intervals: Lagrange's and Newton's divided difference formulae.

Unit-V (9 Hours)

Initial and Boundary value problems **[T1]**

Numerical Solution of ordinary differential equations: Taylor's series, Euler's, modified Euler's and 4th order Runge-Kutta methods, Elliptic partial differential equations: Laplace's and Poisson's equations.

Text Books:

[1]. Grewal B. S. (2017). Higher Engineering Mathematics. (44th Edition).Khanna Publishers.
[2]. SankaraRao K (2014). Numerical Methods for Scientists and Engineers.(3rd Edition). PHI Learning Private Limited.

Reference Books:

[1].KreyszigErwin. (2013). Advanced Engineering Mathematics.(9th Edition).Wiley Publishers.
[2].RamanaB.V.(2007). Higher Engineering Mathematics.TataMc.Graw Hill.
[3].Sastry S.S. (2012). Introductory Methods of Numerical Analysis.(5th Edition). PHI Learning Private Limited.

Web Resources:

[1]. NPTEL:Differential Equations For Engineers
https://nptel.ac.in/courses/111106100
[2].NPTEL: Numerical Analysis
https://nptel.ac.in/courses/111101165
[3].MITOpenCourseware: Differential Equations
https://ocw.mit.edu/courses/18-03-differential-equations-spring-2010/
[4].MITOpenCourseWare: Introduction to Partial Differential Equations
https://ocw.mit.edu/courses/18-152-introduction-to-partial-differential-equations-fall-2011/
[5].MITOpenCourseware: Introduction to Numerical Analysis
https://ocw.mit.edu/courses/18-330-introduction-to-numerical-analysis-spring-2012/

24MA102

DIFFERENTIAL EQUATIONS AND NUMERICAL METHODS

CourseCategory:	**HS**	**Credits:**	**1C**
CourseType:	**Integrated Lab**	**Lecture-Tutorial-Practice:**	**0L-0T-2P**
Pre-requisites:	**Mathematics-II**	**Continuous Assessment:** **Summative Assessment:** **TotalMarks:**	**40** **60** **100**

CourseDescription:

AN OVERVIEW OF THE FUNCTIONS OF MATHWORKS SYMBOLIC MATH TOOL BOX TO SOLVE FIRST ORDER DIFFERENTIAL EQUATIONS, HIGHER ORDER LINEAR PARTIAL DIFFERENTIAL EQUATIONS WITH CONSTANT COEFFICIENTS, ELLIPTIC PARTIAL DIFFERENTIAL EQUATIONS WITH INITIAL AND BOUNDARY CONDITIONS AND FIND ROOT OF TRANSCENDENTAL EQUATIONS.

CourseObjectives:

1. Find solution of first order differential equations.
2. Solve higher order linear differential equations with constant coefficients.
3. Solve elliptic partial differential equations with initial and boundary conditions
4. Find root of transcendental equations.
5. Solve numerically first order initial value problems.

CourseOutcomes:

At theendofthecourse,thestudents willbeable to

CO	CourseOutcomes:	BTL
CO1	Find solution of first order differential equations	(K3)
CO2	Solve higher order linear differential equations with constant coefficients.	(K3)
CO3	Solve elliptic partial differential equations with initial and boundary conditions.	(K3)
CO4	Find root of transcendental equations.	(K3)
CO5	Solve numerically first order initial value problems.	(K3)

Coursearticulationmatrix

ContributionofCourseOutcomestowardsachievementofProgramOutcomes(1 – Low,2--Medium, 3 -- High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2			1						
CO2	2	2			1						
CO3	2	2			1						
CO4	2	2			1						
CO5	2	2			1						

CourseContent

Unit-I (6 Practice Hours)

`dsolve()` function to solve first order differential equations**.**

Unit-II (6 Practice Hours)

`dsolve()` function to solve higher order linear differential equations with constant coefficients

Unit-III (6 Practice Hours)

Laplace's pde solution using finite difference method
Poisson's pde solution using finite difference method

Unit-IV (6 Practice Hours)

`fzero()` function to find roots of an algebraic and transcendental equations
`interp1()` function for interpolation

Unit-V (6 Practice Hours)

Euler's method to solve first order initial value problem
Runge-Kutta 4th order method to solve first order initial value problem
`Ode78()` function to solve first order initial value problems

TextBooks:

MatlabLabManual

WebResources:

- MathWorksOrdinary Differential Equations Documentation
  Solve nonstiff differential equations — medium order method - MATLAB ode45 - MathWorks India
- MathWork Symbolic Calculus Tool Box
  Solve system of differential equations - MATLAB dsolve - MathWorks India
- MathWorks Linear Algebra Documentation
  Linear Algebra - MATLAB & Simulink - MathWorks India
- MathWork Tool Box
  Root of nonlinear function - MATLAB fzero - MathWorks India
- MathWork Tool Box
  1-D data interpolation (table lookup) - MATLAB interp1 - MathWorks India
- MathWork ODE Tool Box
  https://in.mathworks.com/help/matlab/ref/ode78.html#d126e1197289

24PH103 PHYSICS FOR ENGINEERS			
Course Category: Physics (PH)	**Program Core (PC)**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites: 10+2 Physics		**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

Physics is an interdisciplinary field that serves as a bridge between basic science and engineering, applying physical principles to solve engineering problems. This course encompasses modern concepts such as crystallography, X-ray diffraction, and crystal structure determination. It also covers the principles and applications of lasers and optical fibers. Additionally, the course delves into the mechanics, synthesis, characterization, and application of Nanomaterials, including carbon nanotubes.

Course Objectives:

1. Introduce the fundamentals of crystal structure and the techniques for its characterization using X-ray diffraction.
2. Elucidate the core principles of lasers and optical fibers, highlighting their diverse applications in science and technology.
3. Discuss the foundational concepts of mechanics and their formalization for various mechanical applications.
4. Develop skills to understand and apply the principles of physical properties of solids to solve engineering problems.
5. Explain how the dimensionality of materials at the Nanoscale influences their properties, along with exploring numerous industrial applications.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Describe various types of crystal structures and their characterization methods.	K2
CO2	Identify different types of lasers and optical fibers, and their applications.	K2
CO3	Explain the basic concepts of mechanics as applicable to engineering problems.	K2
CO4	Demonstrate the physical properties of solids and their interrelationships.	K3
CO5	Identify the fabrication methods of Nanomaterials and carbon nanotubes, along with their applications in engineering and technology.	K4

Course articulation matrix

COs	POs											PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3												
CO2	3		2										
CO3	3	1											
CO4	3												
CO5	3				1								

(1-Low,2-Medium,3-High)

Course Content

UNIT-I (9 Hours)

Crystallography and Characterization of Materials

Crystallography: Space lattice, basis, unit cell and lattice parameters, Bravais lattices, crystal systems (3 Dimensional), coordination number, packing fraction of SC, FCC, and BCC – Miller indices – separation between successive (hkl) planes.

Characterization of Materials: Introduction, diffraction of X – rays, derivation of Bragg's law, and Bragg's X – ray spectrometer, determination of crystal structure by powder crystal method.

UNIT-II (9 Hours)

Lasers and Optical Fibers

Lasers: Introduction, characteristics of laser, basic principles of lasers (absorption, spontaneous emission and stimulated emission), requirements of lasers (pumping, population inversion, and resonance cavity), solid state laser (Ruby), applications of lasers.

Optical Fibers: Introduction, fundamentals of optical fiber, propagation of light through optical fiber, types of optical fiber, numerical aperture, fractional refractive index change, losses in optical fibers, optical fibers in communication and its advantages.

UNIT-III (9 Hours)

Kinematics of Particle Motion

Kinematics of Rectilinear Motion: Displacement, velocity, and acceleration, uniform motion, motion with uniform acceleration, and motion with variable acceleration.

Kinematics of Curvilinear Motion: Rectangular components of velocity and acceleration, normal and tangential acceleration, motion of projectiles.

UNIT-IV (9 Hours)

Properties of Solids

Properties of Solids: Motion of a particle in a central force field, Kepler's laws (qualitative) and applications, Hooke's law, stress – strain relation, elastic moduli, relation between elastic constants, Poisson's ratio, expression for Poisson's ratio in terms of elastic constants, determination of rigidity modulus by static torsion.

UNIT-V (9 Hours)

Nanomaterials

Nanomaterials: Introduction to Nanomaterials, general properties of Nanomaterials, significance of the Nanoscale (surface to volume ratio, quantum confinement effect), fabrication of Nanomaterials using plasma arcing and chemical vapour deposition methods, characterization of Nanomaterials using SEM and TEM, Carbon nano tubes, SWNT, MWNT, formation of Carbon nanotubes by arc discharge, laser ablation, properties of Carbon nano tubes, Applications of CNTs & nanotechnology.

Text Books:

1. Avadhanulu, M. N. (2019). A textbook of engineering physics (11^{th} ed.). S. Chand Publishing.
2. Tayal, A. K. (2006). Engineering Mechanics: Statics and Dynamics (13th ed.). Umesh Publications.

Reference Books:

1. Halliday, D. Resnick, R., & Walker, J. (2020). Fundamentals of Physics (10th ed.). John Wiley & Sons.
2. Pandey, B.K., & Chaturvedi, S. (2021). Engineering Physics (1st ed.). Cengage Learning.
3. Sharma, S., & Sharma, J. (2018). Engineering Physics (1st ed.). Pearson Education India.
4. Srinivasan, M. R. (2009). Physics for Engineers (1st ed.). New Age International.

Web Resources:

1. X – ray crystallography and Diffraction, NPTEL– Ranjit Kumar Ray, Professor, IIEST Shibpur, IIT Madras, https://onlinecourses.nptel.ac.in/noc22_mm39/preview
2. Introduction to LASER, NPTEL – M. R. Shenoy, Professor, IIT – Delhi, https://onlinecourses. nptel.ac.in/noc21_ph01/preview
3. Fiber Optics, NPTEL – Vipul Rastogi, Professor, IIT – Roorkee, https://onlinecourses.nptel.ac.in/ noc20_ph07/preview
4. Mechanics, NPTEL – Anjani Kumar Tiwari, Professor, IIT – Roorkee, https://onlinecourses.nptel.ac.in/ noc24_me148/preview.
5. Mechanics of Solids, NPTEL – Priyanka Ghosh, Professor, IIT Kanpur, https://onlinecourses.nptel.ac.in/noc22_ce46/preview.
6. Introduction to Nanoscience and Nanotechnology, NPTEL – Swayam, Swapna Nair, Professor, Central University of Kerala, https://onlinecourses.swayam2.ac.in/cec24_cy03/preview

24EN101
COMMUNICATIVE ENGLISH

Course Category:	**HS**	**Credits:**	**4.5C**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3L-0T-3P**
Pre-requisites:	**Intermediate English**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

Communicative English course covers Intercultural Communication, AI in higher education , and Natural Language Processing. It emphasizes effective listening, presentation techniques, innovation, creativity, advanced reading, and technical writing skills, addressing verbal and nonverbal communication fundamentals, processes, barriers, and strategies for confidence and fluency, preparing students for career readiness and leadership.

Course Objectives:

1. Explain the verbal and nonverbal processes of Communication.
2. Familiarize active listening skills and explain the traits of a good listener.
3. Introduce speaking skills for effective presentations.
4. Teach reading techniques to enhance employability skills.
5. Instruct writing techniques to enhance employability skills.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes:	BTL
CO1	Relate and recall the verbal and nonverbal processes of Communication.	(K1)
CO2	Demonstrate active listening skills and acquire the traits of good listener	(K2)
CO3	Apply English speaking skills to deliver effective presentations	(K3)
CO4	Appraise reading techniques like skimming and scanning to enhance employability skills	(K4)
CO5	Assess writing techniques like outlining and clustering to enhance employability skills	(K5)

Course articulation matrix

Contribution of Course Outcomes towards achievement of Program Outcomes (1– Low, 2-- Medium, 3 --High)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1								2	3		2
CO2								2	3		2
CO3								2	3		2
CO4								2	3		2
CO5								2	3		2

Course Content

Unit-I (9 Hours)

Introduction to Communication:

Basics of Communication, Process of Communication, Levels of Communication, Verbal and Nonverbal Communication, Channels of Communication, Barriers to Communication, ***Intercultural Communication.***

Unit-II (9 Hours)

Listening Skills:

Effective Listening, Active Traits of a Good Listener, Listening Modes, Types of Listening, Barriers to Effective Listening, Listening for general content, ***AI in Higher Education: Opportunities, Challenges, and Ethical Considerations.***

Unit-III (9 Hours)

Speaking Skills:

Achieving Confidence, Clarity & Fluency, Effective Presentation Strategies, Meetings, Conferences, Paralinguistic Features, Barriers to Speaking, ***Natural Language Processing.***

Unit-IV (9 Hours)

Reading Skills:

Reading Techniques, Techniques for Good Comprehension, Study Skills, Reading and Interpretation, Intensive, Extensive & Critical Reading, Reading for Different Purposes, ***Innovation and Human Creativity.***

Unit-V (9 Hours)

Writing Skills:

Technical Writing, Importance and Characteristics, Techniques for Good Technical Writing ,Paragraph Construction, Essays, Reports, ***Communication for Career-readiness and Leadership.***

Text Books:

1) Raman,M., & Sharma,S.(2012).*Technical Communication* (2nd ed.). Oxford University Press.

Reference Books:

1) Pushplata, & Kumar, S.(2011).*Communication Skills.* Oxford University Press.
2) Rizvi,A.(2005).Eff*ective Technical Communication*. Tata Mc Graw- Hill Publishing Company Limited.
3) Mishra,S, & Muralikrishna,C.(2006). *Communication Skills for Engineers*. Pearson.

Web Resources:

http://ndl.iitkgp.ac.in/he_document/ekumbh/ekumbh/85?e=5|text%20books%20on%20technical%20communication||| Kulbhushan Kumar. *English for Technical Professionals.*

https://www.gtuelibrary.edu.in/publication/Technical%20communication%205th%20June'09.pdfProf. (Dr.) M. D. Desai, *Technical Communication.*

https://gnindia.dronacharya.info/CSE-AI-ML/Common-Subjects/Downloads/Technical-Communication/Books/Technical-Communication-Book-1.pdf

Technical Communication Principles and Practice
Meenakshi Raman and Sangeeta Sharma

Laboratory Exercises

1) Phonetics.

Introduction – Articulatory Phonetics (The Sounds of Speech Production) – Phonological Concepts (Sound Patterns and Rules) – Practical Applications.

2) Listening Comprehension

Introduction – Strategies for Effective Listening – Types of Listening (Discriminative, Comprehensive, Evaluative, and Appreciative) – Improving Listening Comprehension (Note-taking and Summarizing) – Overcoming Distractions and Misunderstandings – Practice Activities.

3) Conversation Starters- Introducing Self and others

Icebreakers – Introducing Yourself – Introducing Others – Accepting – Declining – Agreeing – Disagreeing – Seeking Clarification – Seeking Permission – Expressing Interest – Offering Help.

4) Just A Minute

Introduction – Rules of the Game (No Hesitation, No Deviation, No Repetition)– Strategies for Success – Benefits of JAM – Common Challenges – Practice Sessions.

5) Situational Dialogues & Role Plays

Introduction – Benefits – Planning and Structuring a Role Play – Everyday Scenarios – Tips for Effective Role Playing – Role Play Practice.

6) Reading Comprehension

Understanding Reading Comprehension – Strategies for Effective Reading – Types of Reading Comprehension Questions – Improving Vocabulary and Context Clues – Practice Exercises – Techniques to Master.

7) Vocabulary

Vocabulary Building –Exploring Prefixes– Discovering Suffixes– Uncovering Roots– Selected Word List (500 Essential Words for Vocabulary Development) – Practical Application.

8) Grammar

Introduction to Grammar Essentials – Understanding Tenses – Mastering Articles – Navigating Prepositions – Practice Exercises – Tips for Improving Grammar Skills.

9) Describing People, Places, Objects and Events

Introduction to Descriptive Language –Describing People – Describing Places – Describing Objects – Describing Events – Practice Activities.

10) Poster Presentation

Introduction – Designing an Effective Poster – Content Development – Presenting Information Visually – Effective Delivery – Tips for Engaging Your Audience.

11) Letter Writing

Introduction – Structure of a Letter – Types of Letters – Writing Techniques – Addressing Envelopes –Practice Activities.

12) Email Writing

Introduction – Parts of an Email – Tone, Style and Language – Email Etiquette – Dos and Don'ts of Professional Email Communication – Organizing Inbox and Responding Promptly – Practice Activities.

Textbook:

Communicative English Lab Manual

References:

1) D. Sudha Rani. (2011). *A Manual for English Language Laboratories*. Pearson, Noida,
2) Nira Konar. (2011). *English Language Laboratories*. PHI Learning Private Limited, New Delhi.

English Language Communication Skills Lab Software:

1) Walden
2) Softx
3) Visionet Spears Digital Language Lab software Advance Pro
4) ODll Language Learner's Software, Orell Techno Systems

24ME101
ENGINEERING MECHANICS
(CE & ME)

Course Category:	**Programme Core (PC)**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:	**10+2 Mathematics & Physics**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

Engineering Mechanics is a fundamental course that builds the analytical foundation required for understanding the behavior of bodies under the influence of forces and motion. It prepares students for advanced mechanical engineering subjects by developing essential problem-solving skills in statics, dynamics, and structural analysis, enabling them to model and evaluate real-world engineering systems effectively.

Course Objectives:

1. Develop a strong foundation in engineering mechanics for analyzing coplanar concurrent, parallel, and general force systems, including forces in plane trusses.
2. Enable students to determine centroids and moments of inertia of various plane figures and material bodies.
3. Provide understanding of mass moments of inertia and their evaluation for different bodies.
4. Build competency in analyzing rectilinear and curvilinear motion of particles.
5. Apply principles of dynamics to analyze the fixed-axis rotation of rigid bodies.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	*Apply* the principles of statics to determine the resultant and equilibrium of coplanar concurrent and parallel force systems.	**K3**
CO2	*Compute* the centroid and moment of inertia for standard and composite plane figures.	**K3**
CO3	*Analyze* coplanar general force systems and plane trusses.	**K3**
CO4	*Apply* the principles of dynamics to solve problems in rectilinear and curvilinear motion of particles.	**K3**
CO5	*Understand* the basic concepts of rigid-body rotation about a fixed axis.	**K2**

Course articulation matrix

COs	POs										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	2									
CO2	3	2									
CO3	3	2									
CO4	3	2									
CO5	3	2									

(1-Low, 2 -Medium, 3–High) (WK8)

Course Content

Unit-I (9 Hours)

Equilibrium of Systems of Concurrent Forces

Composition and resolution of forces – Constraint, Action and Reaction, Types of supports and support reactions, Free body diagram, Equilibrium of concurrent forces in a plane – Method of Projections, Method of moments

Unit-II (9 Hours)

Equilibrium of Systems of Parallel Forces: Introduction, Types of parallel forces, Resultant, Couple, Resolution of Force into force and a couple.

Centroid: Centroids of standard figures, Centroids of Composite Figures.

Area Moments of Inertia: Definition– Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures.

Mass Moment of Inertia: Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, Mass moment of inertia of slender rod, Circular disc. Mass Moment of Inertia of 3D bodies– Cone, Solid cylinder & Sphere.

Unit-III (9 Hours)

Friction: Introduction, limiting friction and impending motion, Coulomb's laws of dry friction, coefficient of friction, Numerical problems.

Coplanar General case of force system: Equilibrium of forces in plane-

Analysis of plane trusses: Method of joints

Unit-IV (9 Hours)

Kinetics of Rectilinear motion: D'Alembert's Principle, Work energy principle, Impulse and Momentum principle.

Kinetics of Curvilinear motion: D'Alembert's Principle, Work energy principle

Unit-V (9 Hours)

Rigid body Motion: Kinematics of rotation: Linear & angular velocity, Linear & angular acceleration in uniformly accelerated motion.

Kinetics of a rigid body in rotation of about a fixed axis: Equation of motion for a rigid body rotating about a fixed axis- Rotation under the action of constant moment

Text Books:

1. Engineering Mechanics by S. Timoshenko & D. H. Young, 4th Edition, 2007, McGraw Hill International Edition. (For Concepts and symbolic Problems).
2. Engineering Mechanics Statics and dynamics by A. K. Tayal, 13th Edition, 2006, Umesh Publication, Delhi, (For numerical Problems using S.I.System of Units).
3. A Textbook of Engineering Mechanics, S.S Bhavikatti. New age international publications 2018.

Reference Books:

1. Engineering Mechanics, P.C.Dumir- S.Sengupta and Srinivas V Veeravalli , University press. 2020. First Edition.
2. Engineering Mechanics, Statics and Dynamics, I.H. Shames., PHI, 2002. 4th Edition.
3. Engineering Mechanics, Volume-I: Statics, Volume-II: Dynamics, J. L. Meriam and L. G. Kraige., John Wiley, 2008. 6th Edition

Web Resources:

1. http://emweb.unl.edu/
2. https://nptel.ac.in/courses/122/104/122104015/
3. Prof. U.S. Dixit, , IIT Guwahati, Engineering Mechanics [English], Web available: https://nptel.ac.in/courses/112103109
4. Prop. K.Ramesh, IIT Madras, Engineering Mechanics, , [English], Web available: https://nptel.ac.in/courses/112106286

24IT103
PROBLEM SOLVING WITH PYTHON

Course Category:	**Engineering Science (ES)**	**Credits:**	**3**
Course Type:	**Integrated Course**	**Lecture-Tutorial-Practice:**	**2-0-2**
Pre-requisites:	Programming through C	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course introduces fundamental programming and problem-solving concepts using Python. It provides students with a solid foundation for computational thinking, program design, and logical reasoning. Students will learn Python syntax, data handling, and modular design techniques. The course emphasizes problem-solving through programming constructs, functions, data structures, and object-oriented principles.

Course Objectives:

- Introduce the foundational concepts of Python programming, syntax, and control structures for computational problem solving. (K1)
- Explain the use of iteration (for, while, nested loops) and loop control statements (break, continue, pass) along with Python string operations for effective sequential processing. (K2)
- Develop proficiency in manipulating strings and core data structures such as lists, tuples, sets, and dictionaries for effective data handling. (K3)
- Demonstrate modular program design using user-defined functions, modules, and exception handling for reliable and reusable software development. (K3)
- Apply object-oriented programming principles — abstraction, encapsulation, inheritance, and polymorphism — to design efficient and scalable applications. (K4)

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the syntax, semantics, and control structures of Python programming for solving computational problems. (K1)	K1
CO2	Explain iteration constructs and loop control statements, with Python string operations for sequential processing. (K2)	K2
CO3	Implement Python's built-in functions and data structures (lists, tuples, sets, dictionaries) for structured data processing. (K3)	K3
CO4	Develop modular and reusable programs using functions, packages, and exception handling mechanisms to improve code efficiency and reliability. (K3)	K3
CO5	Design object-oriented Python solutions applying abstraction, encapsulation, inheritance, and polymorphism for real-world problem-solving. (K4)	K4

Course Articulation Matrix

	POs											PSOs	
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	2	3	2								1	3	2
CO2	3	2	2								2	2	2
CO3	2	2	3								2	2	2
CO4	1	3	3								2	3	1
CO5	1	2	3								2	1	2

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (6 Hours)

Introduction to Python Programming

- **Overview of Python**: Features, installation, execution model, Literals, variables, identifiers, and data types, Input/Output operations and indentation, Operators and expressions
- **Control structures**: Conditional and looping statements: Selection: if, if–else, nested if, if–elif–else

Unit-II (6 Hours)

Iterative Statements & String Handling

- **Iterative Statement**: while, for, nested loops, break, continue, pass, else in loops
- **Strings**: Creation, indexing, slicing, concatenation, String formatting, f-strings, and escape sequences, String methods (upper(), lower(), replace(), split(), join()), Membership operators (in, not in) and iteration, String comparison and manipulation

Unit-III (6 Hours)

Python Data Structures

- **Lists**: Creation, indexing, slicing, mutability, methods (append(), insert(), sort(), remove()), nested lists
- **Tuples**: Creation, immutability, packing/unpacking, tuple operations
- **Sets**: Creating sets, uniqueness, set operations (union(), intersection(), difference()), set comprehension
- **Dictionaries**: Key-value pairs, insertion, deletion, traversal, dictionary methods (items(), keys(), values())

Unit-IV (6 Hours)

Functions, Modules, and Exception Handling

- **Functions**: Definition, parameters, arguments, and return values, Variable scope and lifetime, Recursion and lambda functions
- **Modules and Packages**: Importing and creating modules and their usage.
- **Exception handling**: try, except, finally, and custom exceptions

Unit-V (6 Hours)

Object-Oriented Programming(OOP) in Python

- **OOP concepts**: Classes, objects, attributes, and methods, Constructors, destructors, and encapsulation, Inheritance, polymorphism, Aggregation and composition, Real-world applications of OOP to solve engineering problems(Case Study)

List of experiments

Unit 1:

1. Install Python on Windows / Ubuntu.
2. Print two strings with custom separator and suppress newline; then print "ENDLINE".
3. Check whether number is Odd or Even.
4. Solve a Quadratic Equation using formula.
5. Find Area of a Triangle.
6. Swap two variables.
7. Convert kilometres to miles.
8. Check Leap Year.
9. Check Armstrong Number.
10. Check if number is Positive, Negative or Zero.
11. Attendance percentage program:
    Input working days, absent days
    Calculate attendance and check eligibility (<75%).
12. Road tax calculation based on cost of bike (Slab-based conditional).
13. Grade calculation based on score range (0.0–1.0).
14. Interactive integer reading:
    i. Print binary for positive numbers
    ii. Ignore negative
    iii. Exit when input = 999

Unit 2:

1. Nested-loop patterns:
2. Print Multiplication Table using format().
3. Count how many times a number can be divided by 3 until ≤10.
4. Sum of first 20 terms of sequence 1 + 2 + 4 + 8 + 16 + … using while True + break.
6. Modify 0–100 summation code to use continue and sum only odd numbers.
7. Create student name, roll no, marks inputs and print formatted output using %s, %d, %f.
8. Extract substring between two given substrings.
9. Split each word into two halves based on a given percentage.

10. Find all adverbs and their positions in the given string.
11. Extract date from a string using regex (re.search, strptime).

Unit 3:

1. Accept comma-separated numbers → generate list and tuple.
2. Find tuples divisible by k from list of tuples.
3. Find tuples with all positive elements.
4. Remove duplicate tuples from a list.
5. Row-wise custom addition in a tuple matrix.
6. Extract digits from tuple list → return flat list.
7. Sort dictionary by value (ascending & descending).
8. Convert dictionary string values → int / float.
9. Map each element of list to each item of dictionary (nested dictionary).
10. Convert list → dictionary (odd elements = keys, even = values).
11. Create dictionary from two equal-length lists (keys, values).
12. Input string & pattern → check if characters follow same order.
13. Perform and display union, intersection, difference, and symmetric difference
14. Check whether A is a subset or superset of B
15. Remove Duplicate Words from a Sentence using sets

Unit 4:

1. Two functions:
    - Area of circle
    - Perimeter of circle
2. Rectangle: area & perimeter via functions.
3. Recursive functions for:
    - GCD
    - LCM
    - Factorial
    - Fibonacci
4. showEmployee(name, salary=10000) — default argument.
5. Function to accept variable number of subject marks (variable-length args).
6. Find day of the week given date (use datetime).
8. Program to perform x / y and handle ZeroDivisionError with message.
9. Input list & n — sum first n values; if n invalid → raise IndexError.
10. Student class:
    - Method: check_marks
    - Raise custom exception NotEligibleException if marks < 90.
11. Create a module mymath.py with functions:
    - add(a, b)
    - mul(a, b)

    Write a main program that imports the module and calls these functions.
12. Create a Custom Module With Constants

    Task:
    File: const.py
    Contains:
    PI = 3.14
    GRAVITY = 9.8
    Import it and print both constants.

Unit 5:

1) Design a class **Person** that contains the public attributes:
    - name
    - age

    Create an object and display the stored values.
2) Create a class **Person** with the private attributes:

- __name
- __age

Implement:

- A constructor to initialize the attributes
- A __str__() method to return a formatted representation of the object

3) Develop a class **Person** with:

- Private attributes: __first_name, __last_name, __age
- A **class variable** domain_name used to auto-generate the email
- A method fullname() returning "First Last"
- A __str__() method showing full details including the generated email ID

4) Create an abstract class **AbstractStall** with an abstract method display(). Implement three derived classes:

- **Stall**
- **ExecutiveStall**
- **PremiumStall**

Each subclass should override display() to show details relevant to its type (demonstrating polymorphism).

5) Inheritance with Constructor Execution Order (Employee → Developer)

Define a base class **Employee** and a derived class **Developer**.

Tasks:

- Demonstrate the sequence of constructor calls when the child class is instantiated.
- Print and compare the class attributes of Employee and Developer.

6) Multi-Level OOP with @property and Aggregation (Employee → Developer, Manager)

Build a class hierarchy:

- **Employee** class with @property for the name attribute
- **Developer** class derived from Employee with an additional attribute (e.g., programming language)
- **Manager** class derived from Employee containing a list of employees managed

Include:

- Methods to addEmployee() and removeEmployee()
- A separate **Utility** class to generate a formatted report of employees under each manager

7) Operator Overloading (Bank Entry Counter)

Implement a **Bank** class that tracks the number of persons inside a bank.

Overload operators:

- + to increment count when a person enters
- - to decrement count when a person leaves

This demonstrates operator overloading in a real-world context.

Text Books:

1. R. Thareja, *Python Programming: Using Problem Solving Approach*, 2nd ed., Oxford University Press, 2019

Reference Books:

1. John Guttag, Introduction to Computation and Programming Using Python, MIT Press, 2016.
2. K. Beecher, Computational Thinking: A Beginner's Guide to Problem-Solving and Programming, BCS Learning, 2017.
3. L. Ramalho, Fluent Python, 2nd ed., O'Reilly Media, 2022.
4. B. Downey, Think Complexity: Complexity Science and Computational Modeling, 2nd ed., O'Reilly Media, 2018.
5. S. Hall, Effective Python: 90 Specific Ways to Write Better Python, 2nd ed., Addison-Wesley, 2019.

Web Resources: [Internet]

1. NPTEL. *The Joy of Computing using Python* . Available from: https://archive.nptel.ac.in/courses/106/106/106106182/
2. GeeksforGeeks. *Python Programming Language – Basics* . Available from: https://www.geeksforgeeks.org/python-programming-language/
3. W3Schools. *Python Basics Tutorial* . Available from: https://www.w3schools.com/python/
4. GeeksforGeeks. *Memory Management in Python* . Available from: https://www.geeksforgeeks.org/memory-management-in-python/

5. RealPython. *Understanding Python Objects and Memory Management* . Available from: https://realpython.com/python-memory-management/
6. W3Schools. *Python Strings* . Available from: https://www.w3schools.com/python/python_strings.asp
7. GeeksforGeeks. *Python Data Structures* . Available from: https://www.geeksforgeeks.org/python-data-structures/
8. W3Schools. *Python Lists, Tuples, Sets, and Dictionaries* . Available from: https://www.w3schools.com/python/python_lists.asp
9. RealPython. *Python Functions and Exceptions* . Available from: https://realpython.com/python-functions/
10. W3Schools. *Python Exception Handling* . Available from: https://www.w3schools.com/python/python_try_except.asp
11. AlgoDaily. *Association, Aggregation, and Composition in Python OOP* . Available from: https://algodaily.com/lessons/association-aggregation-composition-casting
12. GeeksforGeeks. *Python OOP Concepts* . Available from: https://www.geeksforgeeks.org/python-oops-concepts/

24UC181
DESIGN THINKING
(CE, ECE, EEE, EIE & ME)

Course Category:	**Engineering Sciences (ES)**	**Credits:**	**1**
Course Type:	**Laboratory**	**Lecture-Tutorial-Practice:**	**0-0-2**
Pre-requisites:		**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**60** **40** **100**

Course Description:

This course introduces first-year undergraduate engineering students to the principles and practices of design thinking, emphasizing user-centred problem-solving and innovation. Students will learn to empathize with users, define problems, ideate solutions, develop prototypes, and test these solutions. The course will also explore the application of design thinking across various engineering disciplines, including Civil Engineering (CE), Electronics and Communication Engineering (EC), Electrical Engineering (EE), Mechanical Engineering (ME), and Information Technology (IT).

Course Objectives:

1. To introduce the fundamental concepts and process of design thinking.
2. To develop students' ability to empathize with users and accurately define engineering problems.
3. To encourage creativity and the generation of a wide range of ideas.
4. To enable students to prototype and test their design solutions.
5. To illustrate the application of design thinking to solve core engineering design problems.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the principles of design thinking.	**K2**
CO2	Apply empathy and problem-defining techniques in engineering contexts.	**K3**
CO3	Employ innovative ideas using various ideation techniques.	**K3**
CO4	Model and test prototypes to validate engineering solutions.	**K4**
CO5	Practice design thinking strategies in civil, electronic, electrical, mechanical, and IT engineering projects	**K3**

Course articulation matrix

	POs										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1								3	3		3
CO2								3	3		3

CO3			3		3	3		3	3		3
CO4					3			3	3		3
CO5					3			3	3		3

(1-Low, 2 -Medium, 3–High) (WK8)

Course Content

Unit-I (6 Hours)

Description: This unit introduces the foundational concepts of design thinking and its importance in solving complex engineering problems.

Introduction to Design Thinking: Introduction to Design Thinking, History and Evolution of Design Thinking, Key Principles and Mindsets, The Design Thinking Process: An Overview, The Role of Design Thinking in Engineering.

Examples/Applications/Case Studies:

- Case Study: How IDEO uses design thinking to innovate.
- Example: Apple's design thinking approach in product development.

Lab/Practice Exercises:

1. Identifying and analyzing engineering problems.
2. Group discussions on real-world design thinking examples.
3. Role-playing to understand user perspectives.

Unit-II (6 Hours)

Description: This unit focuses on understanding users through empathy and accurately defining engineering problems to guide the design process.

Empathize and Define: The Importance of Empathy in Design Thinking, Techniques for Empathy: Interviews, Observations, and Surveys, Defining the Problem: Point of View Statements, Tools for Problem Definition: Journey Maps, Personas, Translating Empathy into Insights.

Examples/Applications/Case Studies:

- Example: Empathy maps in understanding customer needs.
- Case Study: How Airbnb uses empathy in design thinking.

Lab/Practice Exercises:

1. Conducting user interviews.
2. Creating personas and journey maps.
3. Developing problem statements.

Unit-III (6 Hours)

Description: This unit explores creative techniques for generating a wide range of ideas to solve defined engineering problems.

Ideate: The Ideation Phase in Design Thinking, Brainstorming Techniques, Creative Thinking and Innovation, Selecting and Refining Ideas, Overcoming Creative Blocks.

Examples/Applications/Case Studies:

- Example: Brainstorming session in a tech startup.
- Case Study: Google's "20% time" policy for innovation.

Lab/Practice Exercises:

1. Group brainstorming sessions.
2. Idea selection and refinement exercises.
3. Sketching and visualizing ideas.

Unit-IV (6 Hours)

Description: This unit covers the creation of prototypes and the methods for testing and

iterating on these prototypes to develop viable engineering solutions.

Prototype and Test: Prototyping Basics and Importance, Types of Prototypes: Low-fidelity vs. High-fidelity, Tools and Materials for Prototyping, Testing Prototypes: Methods and Techniques, Iterating Based on Feedback.

Examples/Applications/Case Studies:

- Example: Prototyping in the automotive industry.
- Case Study: Iterative prototyping at Dyson.

Lab/Practice Exercises:

1. Building low-fidelity prototypes.
2. Conducting user testing sessions.
3. Analyzing feedback and iterating designs

Unit-V (6 Hours)

Description: This unit examines the application of design thinking across various engineering disciplines, including CE, EC, EE, ME, and IT, to solve engineering design problems.

Design Thinking in Civil Engineering (CE) , Applying Design Thinking in Electronics and Communication Engineering (EC), Design Thinking for Electrical Engineering (EE) , Innovation in Mechanical Engineering (ME), Design Thinking in Information Technology (IT).

Examples/Applications/Case Studies:

- Case Study: Design thinking in sustainable building design (CE).
- Example: Innovation in wearable technology (EC).
- Case Study: Smart grid solutions (EE).
- Example: Prototyping in automotive design (ME).
- Case Study: User-centric software development (IT).

Lab/Practice Exercises:

1. Developing design thinking strategies for a civil engineering project.
2. Prototyping an electronic device solution.
3. Creating user-centric IT solutions

Text Books:

1. Brown, T. (2009). Change by Design: How Design Thinking Creates New Alternatives for Business and Society. Harper Business.
2. Cross, N. (2011). Design Thinking: Understanding How Designers Think and Work.
    1. Berg.

Reference Books:

1. Liedtka, J., & Ogilvie, T. (2011). Designing for Growth: A Design Thinking Tool Kit for Managers. Columbia University Press.
2. Kelley, T., & Kelley, D. (2013). Creative Confidence: Unleashing the Creative Potential Within Us All. Crown Business.
3. Martin, R. L. (2009). The Design of Business: Why Design Thinking is the Next Competitive Advantage. Harvard Business Press.

Web Resources:

1. https://onlinecourses.swayam2.ac.in/aic26_ge05/course

24PH181
PHYSICS LAB

Course Category:	**Programme Core (PC)**	**Credits:**	**1**
Course Type:	**Practical**	**Lecture-Tutorial-Practice:**	**0-0-2**
Pre-requisites:	**10+2 Physics**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**60** **40** **100**

Course Description:

The Engineering Physics laboratory for B. Tech students is designed to provide hands on experience in basic concepts of optics, lasers, optical fibers, waves and oscillators, electricity and magnetism, quantum mechanics, and semiconductors. This course aims to foster the practical skills essential through experimentation, measurement, and analysis for the students of computer science allied branches like CSE, AI-ML, AI-DS, and Information Technology, ECE, EEE, EIE, CE and ME branches. Students will work with advanced equipment under the guidance of experienced faculty to explore various physical phenomena and their engineering applications.

Course Objectives:

1. Demonstrate the basic concepts of wave optics and the experimental evidence of wave nature of light by interference and diffraction phenomena.
2. Provide the experimental knowledge of understanding the properties of semiconductors and their applications.
3. Elucidate the basic concepts of Lasers and Optical fibers and their diverse applications in Science and Technology.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Identify the wave nature of light by the concepts like interference and diffraction of light.	**K4**
CO2	Distinguish the semiconductors based on carrier concentration and Hall coefficient.	**K4**
CO3	Calculate the specific charge of an electron and work function of a photocell.	**K4**
CO4	Demonstrate a comprehensive understanding of wave phenomena, resonance, and their application across various physical systems.	**K3**
CO5	Apply the laser principles, optical fiber transmission characteristics, and their practical applications in telecommunications and photonics.	**K4**

Course articulation matrix

COs	POs										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	**3**										
CO2	**3**										
CO3	**3**				**2**						
CO4	**3**										
CO5	**3**				**2**						

(1-Low, 2 -Medium, 3–High)

Course Content with CO mapping

A. Experiments common to all branches:

1. Solar cell – Determination of fill factor (Common to all branches). (CO2)
2. Hall effect – Hall coefficient measurement (Common to all branches). (CO2)

B. Experiments for CSE, IT, AIDS, and AIML branches:

3. Newton's Rings – Radius of Curvature of a plano convex lens (CO1)
4. Diffraction grating – Wavelength of laser light (CO1,CO5)
5. Photocell – Study of V – I characteristics and determination of work function (CO3)
6. Compound pendulum – Measurement of 'g' (CO4)
7. Specific charge (e/m) of an electron – J. J. Thomson method (CO3)
8. AC Sonometer – Verification of vibrating laws (CO4)
9. Optical Fiber – Determination of Numerical Aperture (CO5)
10. Figure of Merit of a Galvanometer (CO4)
11. Variation of Magnetic field along the axis of current – carrying circular coil (CO3)
12. Diffraction grating – Measurement of wavelength of mercury source (CO1,CO5)

C. Experiments for ECE, EEE, and EIE branches:

3. Figure of Merit of a Galvanometer. (CO4)
4. LCR circuit – Study of Resonance. (CO4)
5. Variation of Magnetic field along the axis of current – carrying circular coil (CO3)
6. Wedge method – Measurement of thickness of a foil. (CO1)
7. Specific charge (e/m) of an electron – J. J. Thomson method (CO3)
8. B-H Curve Unit- Determination of hysteresis loss (CO3)
9. Diffraction grating – Wavelength of laser light (CO1,CO5)
10. Photocell – Study of V – I characteristics, determination of work function. (CO3)
11. Optical Fiber – Determination of Numerical Aperture (CO5)
12. Torsional pendulum-Measurement of Rigidity Modulus (CO4)

D. <u>Experiments for CE and ME branches:</u>

3. AC Sonometer – Verification of vibrating laws (CO4)
4. Wedge method – Measurement of thickness of a foil (CO1)
5. Diffraction grating – Wavelength of laser light. (CO1, CO5)
6. Photocell – Study of V – I characteristics and determination of work function (CO3)
7. Torsional pendulum-Measurement of Rigidity Modulus (CO4)
8. Determination of Dielectric constant of a sample (CO2, CO3)
9. Optical Fiber – Determination of Numerical Aperture (CO5)
10. Compound pendulum – Measurement of 'g' (CO4)
11. Variation of Magnetic field along the axis of current – carrying circular coil (CO3)
12. Figure of Merit of a Galvanometer. (CO4)

Text Books:

1. Panigrahi, S., & Mallick, B. (2015), Engineering Practical Physics (1st ed.). Cengage Learning.
2. Madhusudhana Rao, C. V., & Vasanth Kumar, V. (2015), Engineering Physics Lab Manual (4th ed.). Scitech publications.
3. Ramarao Sri, Choudary Nityanand and Prasad Daruka, "Lab Manual of Engineering Physics"., Vth ed., Excell Books, 2010.

Virtual Lab References:

1. [1] http://vlab.amrita.edu/?sub=1&brch=201&sim=366&cnt=1
2. [2] http://vlab.amrita.edu/?sub=1&brch=195&sim=840&cnt=1
3. [3] http://vlab.amrita.edu/?sub=1&brch=282&sim=879&cnt=1

Web Resources:

1. Web Resources:
2. http://plato.stanford.edu/entries/physics-experiment
3. http://www.physicsclassroom.com/The-Laboratory
4. http://facstaff.cbu.edu/~jvarrian/physlabs.html

24UC182
AI TOOLS & APPLICATIONS
(CE/ECE/EEE/EIE/ME)

Course Category:	**Engineering Science**	**Credits:**	**1**
Course Type:	**Practical**	**Lecture-Tutorial-Practice:**	**0-0-2**
Pre-requisites:	**Nil**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**60** **40** **100**

Course Description:

This course introduces fundamental concepts and practical tools of Artificial Intelligence relevant to all engineering disciplines. It emphasizes the effective and ethical use of AI for productivity, analytical reasoning, research, and real-world engineering applications.

Course Objectives:

1. To provide an overview of AI and its applications in various engineering fields.
2. To demonstrate the use of AI as a personal assistant for productivity enhancement.
3. To explore AI as a tool for logical reasoning and mathematical analytics.
4. To utilize generative AI for literature review, gap analysis, ideation, and article writing.
5. To discuss detailed applications of AI in CE, Electronics, and ME.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the basic concepts of AI and its historical evolution	**K2**
CO2	Apply AI tools for productivity enhancement	**K3**
CO3	Develop logical reasoning and analytical skills using AI tools	**K3**
CO4	Conduct literature reviews and write articles using generative AI	**K3**
CO5	Implement AI solutions in their respective engineering branches	**K3**

24UC101 Essence of Indian Knowledge Tradition			
Course Category:	**Mandatory (MC)**	**Credits:**	**0**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**2-0-0**
Pre-requisites:	**-**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**100** **-** **100**

Course Description:

This course provides an in-depth exploration of the rich Indian knowledge tradition spanning philosophy, scientific advancements, cultural perspectives, educational heritage, and contemporary relevance. Students will delve into foundational texts, philosophical schools, scientific contributions, cultural artefacts, and the impact of Indian knowledge systems on global thought.

Course Objectives:

1. To introduce students to the major philosophical schools (Darshanas) of India and their foundational principles.
2. To familiarize students with significant scientific contributions in mathematics, astronomy, medicine, and technology from ancient India.
3. To explore the cultural perspectives of India through its literature, arts, architecture, and political systems.
4. To understand the educational heritage of ancient India and its impact on holistic learning and societal evolution.
5. To analyse the influence and contemporary relevance of Indian knowledge systems globally.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Analyse and differentiate between the various philosophical schools of India	**K4**
CO2	Assess the contributions of ancient Indian scientists and their impact on global knowledge systems.	**K4**
CO3	Interpret and discuss the cultural and societal norms depicted in Indian literature, arts, and architecture.	**K3**
CO4	Assess critically the educational methods and institutions of ancient	**K4**

	India and their relevance today.	
CO5	Identify the challenges and opportunities in reviving and adapting traditional Indian knowledge systems in contemporary contexts.	**K3**

Course articulation matrix

COs	POs										
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	-	-	-	-	-	-	3	-	1	-	-
CO2	2	-	-	-	-	1	-	-	-	-	-
CO3	-	-	-	-	-	-	2	-	-	3	-
CO4	-	-	-	-	-	1	2	-	-	-	-
CO5	-	-	-	-	-	2	-	-	2	-	-

(1-Low, 2 -Medium, 3–High) (WK9)

Course Content

Unit-I (6 Hours)
Foundations of Indian Philosophy

Introduction to Darshanas; detailed study of Nyaya, Vaisheshika, Sankhya, Yoga, Mimamsa and Vedanta.

Unit-II (6 Hours)
Scientific Advancements

Mathematical theorems of Aryabhata, Astronomical discoveries of Brahmagupta, Principles of Ayurveda, Techniques in Metallurgy and Chemistry.

Unit-III (6 Hours)
Cultural Perspectives

Analysis of Ramayana and Mahabharata, Study of classical texts (Puranas and Shastras), Evolution of temple architecture, Ethical governance principles.

Unit-IV (6 Hours)
Educational Heritage of Ancient India

Gurukul system, Nalanda and Takshashila Universities, Role of women scholars, Influence of Southeast Asian education.

Unit-V (6 Hours)
Influence and Contemporary Relevance

Spread of Indian philosophies to the West, Modern adaptations of Ayurveda, Challenges in preserving oral traditions.

Text Books:

1. Radhakrishnan, S., & Moore, C.A. (Eds.). (1957) *A Source Book in Indian Philosophy*. Princeton University Press.

Reference Books:

1. Basham, A. L. (1954). *The Wonder That Was India: A Survey of the Culture of the Indian Sub-Continent Before the Coming of the Muslims.* Sidgwick & Jackson.

Web Resources:

1. https://iep.utm.edu/category/traditions/indian/
2. https://www.britannica.com/biography/Aryabhata-I
3. https://sacred-texts.com/hin/dutt/index.htm
4. https://nalandauniv.edu.in/
5. https://www.vidhyanjaliacademy.com/gurukul-education-system-in-ancient-india/
6. https://brownhistory.substack.com/p/how-indian-philosophies-influenced

III SEMESTER

24MA201

PROBABILITY AND STATISTICS FOR ENGINEERS

Course Category:	**Basic Science (BS)**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**4-0-0**
Pre-requisites:	**Engineering Mathematics**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

An overview of the Multiplication rule of probability, conditional probability, discrete & continuous probability distributions, sampling distribution, Inference concerning one and two means and statistical control, regression and correlation and their applications in solving engineering problems.

Course Objectives:

- Fundamentals of probability, and cover discrete probability distributions such as Binomial and Poisson.
- Teach continuous random variables and continuous probability distributions, including normal, Uniform, Log-normal, Beta, Gamma, Exponential, and Weibull distributions.
- Explain the concepts of sample and population, sampling distribution of mean and sampling distribution of variance.
- Discuss the estimation of mean, point and interval estimations, hypothesis concerning one and two means.
- Introduce statistical process control through control charts, and discuss correlation and regression analysis.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Apply Bayes' theorem to calculate conditional probabilities and use Binomial and Poisson distributions for decision making.	K3
CO2	Apply continuous random variables to the normal distribution, and other probability distributions.	K3
CO3	Apply sampling distributions of mean and variance for statistical inference	K3
CO4	Implement estimation and hypothesis testing for one and two sample means.	K3
CO5	Apply regression analysis and statistical quality control methods to interpret data and monitor processes.	K3

Course articulation matrix

COs	Pos											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2			1							1		
CO2	3	2			1							1		
CO3	3	2			1							1		
CO4	3	2			1							1		
CO5	3	2			1							1		

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (12 Hours)

Probability Distributions

Conditional Probability, Multiplication rule of Probability, Bayes' theorem.
Random Variables, Binomial Distribution, The Mean and Variance of a Probability Distribution, The Poisson approximation to the Binomial distribution, Poisson Processes.

Unit-II (12 Hours)

Probability Densities

Continuous Random Variables, The Normal distribution, The Normal approximation to the Binomial distribution.
Other probability densities: The Uniform distribution, The Log normal distribution, The Gamma distribution, The Beta distribution, The Weibull distribution.

Unit-III (12 Hours)

Sampling Distributions

Introduction, Populations and Samples, The Sampling distribution of mean (σ known), The Sampling distribution of mean (σ unknown), The Sampling distribution of the variance.

Unit-IV (12 Hours)

Inferences concerning a mean

Point Estimation, Interval Estimation, Test of Hypothesis, Null Hypothesis and Test of Hypothesis, Hypothesis Concerning one mean, Relation between Tests and Confidence intervals, Comparisons - Two Independent Large Samples, Comparisons - Two Independent small Samples.

Unit-V (12 Hours)

Regression Analysis & The Statistical Content of Quality Improvement Programs Contents
Regression Analysis: The method of least squares, Multiple Regression, Correlation.
The Statistical Content of Quality Improvement Programs: Quality Control, Control Charts for Measurements, Control Charts for Attributes.

Text Books:

[1] Richard A. Johnson (2011). Miller & Freund‘s Probability and Statistics for Engineers (Eighth edition). Prentice Hall of India.

Reference Books:

[1] R. E. Walpole, S. L. Myers, R. H. Myers and Keying E.Ye (2007). Probability & Statistics for Engineers & Scientists Sixth Edition, Pearson Prentice Hall.

[2] Purna Chandra Biswal (2007). Probability and Statistics. Prentice Hall of India.

[3] Dr. T. K. V. Iyengar, Dr. M. V. S. S. N. Prasad, S.Ranganatham, Dr. B. Krishna Gandhi (2012) Probability and Statistics, S. Chand.

Web Resources:

[1] probweb.berkeley.edu/teaching.html

[2] statsci.org/teaching.html

[3] video lectures.nptel.iitm.ac.in

24EE211 ELECTRICAL AND ELECTRONICS ENGINEERING			
Course Category:	Engineering Science (ES)	**Credits:**	3
Course Type:	Theory	**Lecture-Tutorial-Practice:**	3-0-0
Pre-requisites:	Engineering mathematics, Engineering Physics	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	40 60 100

Course Description:

This course provides a comprehensive introduction to the fundamentals of electrical engineering. It covers the analysis of DC and AC circuits, focusing on key components, circuit laws, and basic analysis methods. Students will learn the construction and operation of DC machines, induction motors, and transformers. The course also explores semiconductor devices such as diodes and transistors, emphasizing their characteristics and practical applications. By the end of the course, students will gain essential skills for analyzing and understanding basic electrical and electronic systems.

Course Objectives:

- To provide a foundational understanding of DC and AC circuits, including basic components, circuit laws, and analysis techniques such as mesh and nodal analysis.
- To introduce the construction, operation, and performance characteristics of DC machines, three-phase induction motors, and single-phase transformers.
- To explain the working principles and applications of semiconductor diodes, including rectifiers, Zener diodes, and voltage regulation.
- To explore the operation of bipolar junction transistors (BJTs) in various configurations and their use as amplifiers and switches.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Apply mesh and node analysis to DC and AC circuits, and calculate RMS and average values for AC wave forms.	[K3]
CO2	Understand the working principles and characteristics of DC generator and motor.	[K2]
CO3	Understand the working principles and characteristics of three phase induction motor and transformer.	[K2]
CO4	Understand the working principles and characteristics of PN junction diode, Zener diode and rectifier circuits.	[K2]
CO5	Understand the CB CC CE configurations of transistors.	[K2]

Course articulation matrix

	POs											PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3		2								1	1	
CO2		1		2								1	1	
CO3			3	2								1	1	
CO4			3	2								1	1	
CO5			3	2								1	1	

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (9 Hours)
DC and AC circuits

DC circuits: Introduction, basic circuit components- resistors, inductors, capacitors, Ohm's law and its limitations, Kirchhoff's laws, ideal independent voltage source, Ideal independent current source, dependent sources, practical voltage and current sources, mesh and nodal analysis (with independent sources only).

AC circuits: Generation of AC voltages, waveforms and basic definitions, relationship between frequency, speed and number of poles, root mean square and average values of alternating current and voltages, form factor and peak factor.

Unit-II (9 Hours)
DC Machines

DC Machines: Introduction, construction of dc machines, types of dc machines, armature windings, operation of a dc machine as a generator, operation of dc machine as a motor, generation of dc voltage dc generator, torque production in a dc motor, speed control of dc motors

Unit-III (9 Hours)
AC Machines

Induction Motors: Introduction, constructional features of three-phase induction motors, principle of operation of three-phase induction motor-slip and rotor frequency, voltage and current equations and equivalent circuit of an induction motor.

Transformers: Introduction, constructional features of single phase transformers, principle of operation of single-phase transformers, EMF equation of single-phase transformers, equivalent circuit of single-phase transformers, auto transformer.

Unit-IV (9 Hours)
Semiconductor Diode and its Characteristics

Semiconductor diode and its characteristics : Conductors, semiconductors, insulators, P-N junction (diode), operation of P-N junction diode (forward and reverse bias), V-I characteristics of diode (forward and reverse bias), Zener diode, Zener diode as a voltage regulator, half wave, full wave, bridge rectifiers and its ripple factor calculations.

Unit-V (9 Hours)
Bipolar Junction Transistor (BJT) Characteristics

Transistor operation, types of transistors(NPN&PNP),regions of operation of transistors, transistor as an amplifier, transistor as a switch, common base configuration (CB), common emitter configuration(CE),common collector configuration(CC), comparison of CB,CC,CE configurations.

Text Books:

1. I.J.Nagrath and Kothari , —Theory and problems of Basic Electrical Engineering‖, Prentice-Hall of India Pvt. Ltd.
2. Dr. K. Uma Rao, Dr. A. Jayalakshmi, —Basic Electric Engineering‖, Pearson Publications.

3. T.K. Nagasarkar and M.S. Sukhja,: Basic Electric Engineering:, oxford University press.
4. R.L. Boylestad & amp;Louis Nashlesky, Electronic Devices&CircuitTheory, Pearson Education, 2021.

REFERENCE BOOKS:

1. AshfaqHusain , HaroonAshfaq,‖*Fundamentals of Electrica lEngineering*‖, 4th edition, Dhanpat Rai & Co , 2014.
2. I.J.Nagrath and Kothari,—*Theory and problems of Basic Electrical Engineering*‖, 2nd edition, Prentice-Hall of IndiaPvt.Ltd.,2016.
3. R.S.Sedha, A Text book of Electronic Devices and Circuits, S. Chand & Co, 2010.
4. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, PrenticeHall, India, 2002.

Web Resources:

E-resources and other digital material

[1] https://nptel.ac.in/courses/122106025
[2] https://nptel.ac.in/courses/108105053

24ME201 MECHANICS OF MATERIALS

Course Category:	**Program Core (PC)**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:	**Engineering Mechanics**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course introduces the fundamental principles governing the behavior of solid materials under various types of loading. It builds upon the concepts of statics to analyze stresses, strains, and deformations in structural and machine components. Students will learn to apply analytical methods to determine the strength, stiffness, and stability of engineering members subjected to axial, torsional, bending, and combined loadings. The course emphasizes both theoretical understanding and practical applications to mechanical, civil, and aerospace engineering problems.

Course Objectives:

- Introduce the fundamental concepts of stress, strain, and deformation in materials subjected to different types of loading.
- Develop the ability to apply Hooke‘s law and stress–strain relationships for analyzing elastic behavior of materials.
- Analyze structural members such as bars, shafts, beams, and columns under axial, torsional, bending, shear, and combined loading.
- Understand failure criteria and safety factors to ensure safe design of engineering components.
- Provide knowledge of deflection and stability analysis in beams and columns.
- Equip students with analytical and problem-solving skills necessary for designing load-bearing members in mechanical and structural systems by relating mechanics principles to real-world engineering applications.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Estimate the stresses and strains in structural members subjected to axial loading.	K3
CO2	Inspect Shear force and Bending moment diagrams for determinate beams which are subjecting to transverse loading	K4
CO3	Analyze the members subjected to bending and torsion.	K4
CO4	Examine the deflections of determinate beams and safe load on columns	K4
CO5	Solve plane stress problems and calculate the stresses in thin cylindrical and spherical vessels.	K3

Course articulation matrix

	POs											PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**1**									**2**	**1**	
CO2	**2**	**3**	**1**									**2**	**1**	
CO3	**2**	**3**	**1**									**2**	**1**	
CO4	**2**	**3**	**1**									**2**	**1**	
CO5	**2**	**3**	**1**									**2**	**1**	

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (9 Hours)

Tension, compression and shear

Introduction, Concepts of Normal Stress and Strain, Stress-Strain Diagrams, Elasticity and Plasticity, Linear Elasticity and Hooke‘s Law, Poisson‘s Ratio, Shear Stress and Strain, Allowable Stresses and Allowable Loads. Numerical problems on Change in length of axially loaded members, Change in length for a tapered bar under axial loading.

Unit-II (9 Hours)

Statically determinate beams

Introduction, Types of Beams, Loads and Reactions, Shear Force and Bending Moments, Relationships between Load, Shear Force and Bending Moment, Shear Force and Bending Moment Diagrams.

Unit-III (9 Hours)

Bending and Torsion

Bending stresses: Introduction, Pure bending, Bending stress Equation, Design of beams for bending stresses.

Torsion: introduction, torsional deformations of circular bar, circular bars of linearly elastic materials, transmission of power by circular shafts.

Unit-IV (9 Hours)

Beam deflections and columns

Deflections of statically determinate beams: Introduction, Differential Equations of the Deflection Curve, Deflections by Integration of the Bending Moment Equation, Macaulay‘s Method.

Columns: Introduction, Buckling and Stability, Columns with Pinned ends, Columns with other support conditions, Limitations of Euler‘s Formula, Rankine‘s Formula.

Unit-V (9 Hours)

Principal Stresses and Pressure Vessels

Analysis of plane stress: Introduction, Plane Stress, Principal Stresses and Maximum Shear Stress. Mohr‘s Circle for Plane Stress.

Thin cylindrical and spherical pressure vessels: Introduction, Stresses in thin cylindrical and spherical pressure vessels subjected to internal pressure. Effect of internal pressure on the dimensions of the thin cylindrical and spherical pressure vessels.

Text Books:

[1] James M. Gere and Barry J.Goodno, —Mechanics of Materials‖, Eighth edition, CENGAGE Learning, 2013

[2] Egor Paul Popov, —Mechanics of Materials‖, Second edition, Pearson Education, 2015

Reference Books:

[1] R.K.Bansal, —Strength of Materials ‖Sixth edition, Laxmi Publishers, 2017

[2] Dr. Sadhu Singh, ‖Strength of Materials‖, Ninth edition, Khanna Publishers, 2007.

[3] R.K. Rajput,— Strength of Materials ‖,First Edition, S.Chand& Company, 2006.

[4] S.S.Rattan, —Strength of Materials‖, Third Edition, Tata McGraw Hill Education Private Limited, 2017

E-resources and other digital material:

[1] Prof. M.S. Sivakumar, IIT Madras, Strength of material, [English],

Web Available: http://nptel.ac.in/courses/112106141/

[2] Dr. Satish C Sharma, IIT Roorkee, Strength of material, [English],

Web Available: http://nptel.ac.in/courses/112107146/

[3] Dr. S. P. Harsha, IIT Roorkee, Strength of material, [English],

Video Available: http://nptel.ac.in/courses/112107147

24ME202 ENGINEERING THERMODYNAMICS

Course Category:	**Program Core (PC)**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:	**Engineering Physics**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course introduces the principles of thermodynamics, focusing on energy interactions, the laws of thermodynamics, entropy, and exergy with applications to engineering systems. Topics include gas mixtures, pure substance properties, steam tables, and power cycles such as Rankine, Otto, Diesel, and Dual cycles.

Course Objectives:

- Introduce the fundamental concepts, definitions and laws of thermodynamics for analyzing energy and work interactions.
- Develop an understanding of the First Law of Thermodynamics and its application to closed and open systems.
- Explain the Second Law of Thermodynamics, entropy, irreversibility and exergy for evaluating the performance
- Familiarize students with thermodynamic properties of pure substances, gas mixtures and the use of property tables, charts, and equations of state.
- Apply thermodynamic principles in analyzing and comparing vapor and air power cycles such as Rankine, Otto, Diesel, and Dual cycles.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Illustrate the basic concepts of thermodynamics and can distinguish work and heat forms of energy.	K2
CO2	Apply first of law of thermodynamics to flow and non-flow processes and thermodynamic systems	K3
CO3	Apply the second law of thermodynamics to systems and understand the concept of entropy, exergy and irreversibility.	K3
CO4	Evaluate the properties of steam, gas mixtures	K3
CO5	Analyze the performance of Rankine and air standard cycles	K3

Course articulation matrix

	POs											PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**3**	**3**										**3**	
CO2	**3**	**3**	**3**	**2**									**3**	
CO3	**3**	**3**	**3**				**2**						**3**	
CO4	**3**	**3**	**3**	**2**	**2**								**3**	
CO5	**3**	**3**	**3**	**2**	**2**		**2**						**3**	

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (9 Hours)

Fundamental concepts and definitions: Thermodynamic system, type of systems Macroscopic and microscopic points of view, properties and state of a substance, Thermodynamic equilibrium and Quasistatic Process, thermodynamic path, cycle, Zeroth law of thermodynamics, Temperatures scales

Work and Heat: Ideal gas equation, equation of state, Work transfer, pdV-work and heat transfer in various quasistatic processes, flow work, path function and point function, heat transfer-A path function, comparison of heat and work.

Unit-II (9 Hours)

First law for non-flow systems: Joule Experiment in establishing First law of thermodynamics, First law of thermodynamics for a system undergoing a cycle and for a change in state of system, Energy-a property of a system, internal energy and enthalpy, constant volume and constant pressure specific heats and their relation to internal energy and enthalpy of ideal gases.

First law for flow systems: Control mass and control volume, first law of thermodynamics for a control volume, steady flow energy equation and application to engineering equipment.

Unit-III (9 Hours)

Second law of thermodynamics: Cyclic heat engines and Refrigerators, Kevin Planks and Clausius statements, Equivalence of Kelvin Planck and Clausius statements, Carnot cycle, Carnot theorem and its corollary, absolute thermodynamic temperature scale, efficiency of reversible heat engine and COP of reversed heat engine, Causes of irreversibility, Concept of Exergy and irreversibility (Theory).

Entropy: Clausius Theorem, property of entropy, Inequality of Clausius, Entropy change in irreversible process, Entropy principle, Problems on entropy change and entropy generation in system during change of state, T-ds relations.

Unit-IV (9 Hours)

Properties of gas mixtures: Properties of mixture of gases-Dalton`s law of Partial Pressures, Internal Energy, enthalpy and specific heats of gas mixtures and Entropy of gas mixtures

Pure substances: P-v, P-T, T-s and h-s diagrams for a pure substance, Triple point, Critical point, Dryness fraction, Steam tables, problems using steam tables and Mollier chart.

Unit-V (9 Hours)

Vapour and air power cycles: Ideal Rankine cycle, Otto cycle, Diesel cycle and Dual cycle

Text Books:

[1] P. K. Nag, —Engineering Thermodynamics‖ 6th edition, Tata Mc Graw Hill Education Private Limited, 2017.

[2] Mahesh M. Rathore, Thermal Engineering, Tata McGraw-Hill Education, 2010

[3] G.J.Van Wylen & Sonntag, —Fundamentals of Classical Thermodynamics‖, 4th Edition, Wiley publication 2005

Reference Books:

[1] Yunus A. Cengel and Michael A. Boles, —Thermodynamics – An Engineering Approach‖, 8th edition, McGraw Hill Education (India) Private Limited, 2014.

[2] R.K. Rajput, Thermal Engineering, Lakshmi Publications Limited, 2020.

E-resources and other digital material:

[1] www.learnthermo.com/tutorials.php

[2] www.khanacademy.org/science/physics/ thermodynamics

[3] www.courseera.org/learn/ thermodynamics -intro

[4] www.edx.org/course/thermodynamics -iitbombayx-me209-1x-1

[5] http://nptel.ac.in/courses/112106141

[6] http://nptel.ac.in/courses/112108148

Note: Steam tables are permitted in internal and external examinations

24ME203 KINEMATICS OF MACHINES			
Course Category:	**Program Core (PC)**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:	**Engineering Graphics** **Engineering Mechanics**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course introduces the fundamental principles of motion in machines and mechanisms. It covers the classification of mechanisms, mobility analysis, and the study of kinematic chains, inversions, and constrained motions. Students will learn to perform velocity and acceleration analysis of linkages using graphical method, as well as apply the concept of instantaneous centers. The course further emphasizes the graphical synthesis of cam profiles for different types of followers and the kinematic synthesis of mechanisms to achieve specific motion requirements. In addition, it provides a comprehensive study of gears, gear tooth profiles, interference, and gear trains including simple, compound, reverted, and epicyclic systems. By the end of the course, learners will gain the ability to analyze and design fundamental machine mechanisms used in automotive, industrial, and robotic applications.

Course Objectives:

- Introduce the fundamentals of mechanisms and machines by studying links, kinematic pairs, chains, and inversions to understand constrained motion and mobility.
- Develop the ability to analyze velocities and accelerations in simple mechanisms using graphical method, including instantaneous centers.
- Provide knowledge of cam design and graphical synthesis of cam profiles for different types of followers to achieve desired motion characteristics.
- Introduce the principles of kinematic synthesis to design mechanisms for tasks such as function generation, rigid body guidance, and path generation.
- Equip students with the ability to analyze gears and gear trains by understanding tooth profiles, interference, and motion transmission in simple, compound, reverted, and epicyclic gear systems.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Analyze different mechanisms used in machines and everyday life.	K2
CO2	Evaluate velocity and acceleration of various links in a Mechanism	K4
CO3	Develop cam profiles for different followers	K3
CO4	Apply the analytical techniques for Synthesis of Mechanisms	K4
CO5	Determine parameters of gears and gear trains	K4

Course articulation matrix

	POs											PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1										3	2	
CO2	3	1										3	2	
CO3	3	1										3	2	
CO4	3	1										3	2	
CO5	3	1										3	2	

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (9 Hours)

INTRODUCTION: Mechanisms and machines, Rigid and resistant bodies, Link, Kinematic pair, Types of joints, Constrained motions, Degrees of Freedom, Classifications of Kinematic pairs, kinematic-chain, Linkage, mechanism and structure, Classification of mechanisms, Inversions of Mechanism- Four - Link (bar) chain, Single Slider - Crank Chain, Double – Slider Crank Chain.

Unit-II (9 Hours)

VELOCITY AND ACCELERATION ANALYSIS:

Introduction, Absolute and Relative Motion, Vectors, Addition and subtraction of Vectors, Motion of a Link, Velocity and Acceleration analysis for simple mechanisms, Velocity and Acceleration of Intermediate and offset points, Angular velocity and Angular acceleration of Links of simple mechanisms: Instantaneous center, Notation, Number of I - Centers, Kennedy's theorem, Locating I - Centre's, Angular velocity by I - Centre Method for simple mechanisms (Four bar and single slider).

Unit-III (9 Hours)

CAMS:

Introduction, Types of cams, Types of Followers, Definitions, Graphical synthesis of cam profile limited to reciprocating & radial follower. (Knife Edge, Roller and flat faced Followers**)**

Unit-IV (9 Hours)

KINEMATIC SYNTHESIS : Stages of synthesis-Concepts of type, Number and dimensional synthesis - Tasks of dimensional synthesis, Concepts of function generation, Rigid body guidance and path generation, Freudenstein's equation for function generation using three precision points for four bar mechanism. (3 precision points only).

Unit-V (9 Hours)

GEARS: Introduction, Classification of Gears, Terminology, Law of Gearing, Velocity of Sliding, Forms of Teeth- Cycloidal Profile Teeth, Involute Profile Teeth, Comparison of Cycloidal and Involute tooth forms, Length of Path of contact, Length of Arc of contact, Number of pairs of Teeth in contact, Concept of Interference in Involute Gears, Minimum number of Teeth in Involute Gears,

GEAR TRAINS: Introduction, simple Gear Train, Compound Gear Train, Reverted Gear train, Planetary or Epicyclic Gear Train, Analysis of Epicyclic Gear Train (Tabular method only)**.**

Text Books:

[1] S.S.Rattan, Theory of Machines, 4th Edition, 2014, TMH.

[2] Robert L Norton. —Kinematics & Dynamics of Machinery‖, 2017. Mc Graw Hill Education

Reference Books:

[1] R S Khurmi, Theory of Machines.14th Edition, S.Chand & Company Ltd. Eurasia Publishing House

[2] Ghosh and Mallik, Theory of Mechanisms and Machines, 3rd Edition,2006 East West Press

[3] Dr. R. K. Bansal & Dr. J. S. Brar, Theory of Machines 4th Edition, 2009, Lakshmi publications

Web Resources:

[1] http://nptel.iitg.ernet.in/Mech_Engg/IIT%20Delhi/Kinematics%20of%20Machines.htm

[2] http://freevideolectures.com/Course/2359/Kinematics-of-Machines

[3] http://www.rapidmaniac.com/search/relevant/All/solution-manual-kinematics-and- dynamics-of machines

24ME281 SOLID MODELLING LAB			
Course Category:	**Program Lab**	**Credits:**	**1.5**
Course Type:	**Laboratory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:		**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**60** **40** **100**

Course Description:

The Solid Modelling Lab provides hands-on experience with 3D experience software to develop essential skills in computer-aided design and modeling. Students will learn to construct precise 2D sketches, create 3D part models, and assemble components into complete mechanical systems. The course also covers the translation of geometric models into various file formats to ensure compatibility with different CAD/CAM platforms. Through practical exercises, students will gain a strong foundation in solid modeling techniques used in modern Engineering design and Manufacturing.

Course Objectives:

1. To enable students to create accurate 2D sketches and develop 3D part models using 3D experience software.
2. To Equip students with skills to Assemble Multiple part Models into functional Mechanical Assemblies.
3. To train students in converting geometric models into different file formats for seamless integration across CAD/CAM platforms.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Construct 2D Sketches in a Modeling Software	K3
CO2	Develop part models of machine components	K3
CO3	Combine part models of machine components for assembly	K4
CO4	Translate geometric models to other file formats.	K4

Course articulation matrix

COs	POs											PSOs		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**				**3**								**3**	**2**
CO2	**3**				**3**								**3**	**2**
CO3	**3**				**3**								**3**	**2**
CO4	**3**				**3**								**1**	**2**

(1-Low, 2 -Medium, 3–High)

Course Structure:

CONTENTS:

1. Construction of 2D sketches.
2. Modelling of simple machine components.
3. Assembly of Machine components.
4. Orthographic views of the assembled components.
5. Solid modelling of real components

6. Exporting the files to other file formats
7. Group assignment topic

LIST OF EXPERIMENTS:

1. Part drawing & Assembly of Screw jack
2. Part drawing & Assembly of Stuffing Box
3. Part drawing of Marine engine connecting rod end
4. Part drawing & Assembly of Single tool post
5. Part drawing & Assembly of Socket and spigot joint
6. Part drawing & Assembly of Foot-step bearing
7. Develop various types of GI pipe fittings
8. Develop double strap diamond butt joint

Text Books:

[1] Pro/Engineer Wildfire 5.0 by Roger Toogood, Jack Zecher, SDC Publications.

[2] Machine Drawing by K.L Narayana, P.Kannaiah, K.Venkata Reddy, Publisher: New Age International

Reference Books:

[1] Parametric Modeling with Pro/ENGINEER Wildfire 5.0

[2] Parametric Modeling with Creo Parametric 1.0

E-Resources and other Digital Material

[1] http://www.proetutorials.com/

[2] http://learningexchange.ptc.com/tutorials/by_sub_product/p tc-creo-elements-pro-pro- engineer/sub_product_id:1

[3] http://www.eng-tips.com/viewthread.cfm?qid=48209

[4] https://catiatutor.com/

[5] www.v5train.com

Web Resources:

NPTEL Video references:

[1] https://www.youtube.com/watch?v=c2VtgkfZ2BQ

[2] https://www.youtube.com/watch?v=hjgGxl4Yk_M

[3] https://www.youtube.com/watch?v=xsKtzWBZ5FY

[4] https://www.youtube.com/watch?v=rIFeKNzm4gE

[5] https://www.youtube.com/watch?v=uCdypjnnKto

[6] https://www.youtube.com/watch?v=YIzwA_Wlj_M

24EE285
ELECTRICAL AND ELECTRONICS ENGINEERING LAB

Course Category: Engineering Science	**Program Core (PC)**	**Credits:**	**1.5**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**0-0-3**
Pre-requisites:		**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**60** **40** **100**

Course Description:
This course offers practical experiments in Electrical (machines, transformers, circuit laws) and Electronics (diodes, rectifiers, transistors) to reinforce core concepts. It builds essential skills in analyzing, testing, and verifying electrical and electronic devices.

Course Objectives:
The course aims to provide practical exposure to core concepts of Electrical and Electronics Engineering through hands-on experiments. It develops skills in analyzing, testing, and verifying the performance of electrical machines and electronic devices.

Course Outcomes:
At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Design and conduct experiment.	**6**
CO2	Analyze and present experimental results.	**4**
CO3	Exhibit professional behavior	**3**

Course articulation matrix

COs	POs											PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1			2	3					3	1		3	3	
CO 2				2					3	3		3	3	
CO 3				2					3	3				

(1-Low, 2 -Medium, 3–High)

Course Content

Part-A Electrical Engineering:

1. Verification of KCL and KVL
2. Determination of parameters of choke coil
3. Open circuit characteristics of a separately excited DC generator
4. Brake test on DC shunt motor
5. Brake test on three phase induction motor
6. OC and SC test of the transformer

Part – B Electronics Engineering

1. Obtain the V-I characteristics of PN junction diode
2. Obtain the V-I characteristics of Zener diode
3. Verify the output waveforms of the rectifier and calculate the ripple factor.
4. Obtain the input and output characteristics of a transistor in CB configuration
5. Obtain the input and output characteristics of a transistor in CE configuration
6. Obtain the input and output characteristics of a transistor in CC configuration

Minimum of 5 experiments must be conducted from Part A and Part B

24UC201
Universal Human Values-II: Understanding Harmony

(Common to all Branches of Engineering)

Course Category:	**Mandatory Course (MC)**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**2-1-0**
Pre-requisites:	**UHV-I** (in Student Induction Program)	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

The course is mandated by AICTE for all B.Tech. Students of all branches, preferably in the second year. It is intended to facilitate the development of a holistic and humane world vision. This course employs an innovative and effective methodology of self-exploration, self-verification on one's own right. It is presented as a systematic set of universal, rational and verifiable proposals about human reality, about the inherent harmony in the human being, the family, society, the entire nature and existence. It draws out the value or role of human being in the harmony at all these levels, which is essentially the scope of ethical human conduct. It further helps to find resolution of present-day challenges. The issues in professional ethics are analysed in the context of the understanding of harmony. While handling the course, the teacher is also a co-explorer along with the students.

Course Objectives:

1. Help the students appreciate the essential complementarily between _values' and _skills' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. Facilitate the development of a holistic perspective among learners towards life and profession.
3. Facilitate the right understanding of happiness and prosperity based on correct understanding of human reality and the rest of existence.
4. Identify that a holistic perspective forms the basis of universal human values and movement towards value-based living in a natural way.
5. Highlight plausible implications of holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Apply the right understanding of the concepts of value education and basic human aspirations through self-exploration for the fulfillment of human aspirations.	**K3**
CO2	Analyse various aspects of the human being as the combination of Self and Body for attaining harmony at the level of human being (individual).	**K4**
CO3	Apply the knowledge of nine universal values in human-human relationship	**K3**

	for harmony at the level of family, and appreciate all the essential factors that help in attaining harmony at the level of society.	
CO4	Differentiate the characteristics and activities of various orders of Nature and study the mutual fulfillment among them, and also identify the existence as co-existence at all levels.	**K4**
CO5	Present sustainable solutions to various challenges in society and Nature, and identify that the solutions are practicable.	**K3**

Course articulation matrix

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	-	-	-	-	-	-	-	-	-	3	-	-	
CO2	3	-	-	-	-	-	-	-	-	-	3	-	-	
CO3	3	-	-	-	-	-	-	2	2	-	3	-	-	
CO4	3	-	-	-	-	-	-	2	2	-	3	-	-	
CO5	3	-	-	-	-	-	3	3	3	-	3	-	-	

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (4 lectures + 2 tutorials)

Course introduction, need, basic guidelines, content and process for value education
Contents

Purpose and motivation for the course, recapitulation from UHV-I, Self-exploration: what is it?, its content and process, _Natural acceptance‘ and experimental validation – as the process for self-exploration, Continuous happiness and prosperity – a look at basic human aspirations.

Right understanding, relationship and physical facility – 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.

Unit-II (4 lectures + 2 tutorials)

Understanding Harmony in the Human Being – Harmony in Myself
Contents

Understanding human being as a co-existence of the sentient _I‘ and the material _Body‘. Understanding the needs of Self (_I‘) and _Body‘ – happiness and physical facility, 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 Health; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Health.

Unit-III (4 lectures + 2 tutorials)

Understanding Harmony in the Family and Society – Harmony in Human-Human Relationship
Contents

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship, Understanding the meaning of Trust; Difference between intention and competence, Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.
Understanding the harmony in the society (society being an extension of family); Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society–Undivided Society, Universal Order–from family to world family.

Unit-IV (4 lectures + 2 tutorials)

Understanding Harmony in Nature & Existence – Whole existence as Coexistence

Contents

Understanding the harmony in the Nature, Inter-connectedness and mutual fulfillment among the four orders of Nature – recyclability and self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

Unit-V (4 lectures + 2 tutorials)

Implications of the above Holistic Understanding of Harmony on Professional Ethics

Contents

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, c) ability to identify and develop appropriate technologies and management patterns for above production systems, 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.

Text Books:

1. Gaur, R.R., Sangal, R, &Bagaria, G.P. (2010). *A Foundation Course in Human Values and Professional Ethics*, Excel Books Private Limited, New Delhi.
2. Gaur, R.R., Asthana, R, &Bagaria, G.P. (2019) *A Foundation Course in Human Values and Professional Ethics* (2nd revised edition). Excel Books Private Limited, New Delhi.

Reference Books:

1. Jeevan Vidya: EkParichaya, A. Nagaraj, Jeevan VidyaPrakashan, Amarkantak (1999).
2. Human Values, A. N. Tripathi, New Age International Publishers, New Delhi (2004).
3. The Story of Stuff: The impact of overconsumption on the planet, our communities, and our health and how we can make it better, Annie Leonard, Free Press, New York (2010).

4. The story of my experiments with truth: Mahatma Gandhi Autobiography, Mohandas Karamchand Gandhi, B. N. Publishing (2008).
5. Small is beautiful: A study of economics as if people mattered, E. F. Schumacher, Vintage Books, London (1993).
6. Slow is beautiful: New Visions of Community, Cecile Andrews, New Society Publishers, Canada (2006).
7. Economy of Permanence, J. C. Kumarappa, Sarva-Seva-SanghPrakashan, Varanasi (2017).
8. Bharat Mein Angreji Raj, PanditSunderlal, PrabhathPrakashan, Delhi (2018).
9. Rediscovering India, Dharampal, Society for Integrated Development of Himilayas (2003).
10. Hind Swaraj or Indian Home Rule, M. K. Gandhi, Navajivan Publishing House, Ahmedabad (1909).
11. India Wins Freedom: The Complete Version, Maulana Abul Kalam Azad, Orient Blackswan (1988).
12. The Life of Vivekananda and the Universal gospel, Romain Rolland, AdvaithaAshrama, India (2010).
13. Mahatma Gandhi: The Man who become one with the Universal Being, Romain Rolland, Srishti Publishers & Distributors, New Delhi (2002).

Web Resources:

- Textbook-1: https://dokumen.pub/a-foundation-course-in-human-values-and-professional-ethics-firstnbsped-9788174467812.html
- AICTE – SIP Youtube Channel: https://www.youtube.com/channel/UCo8MpJB_aaVwB4LWLAx6AhQ
- AICTE – UHV Teaching Learning Material: https://fdp-si.aicte-india.org/download.php#1

IV SEMESTER

24ME204 Engineering Materials & Metallurgy			
Course Category:	**Program Core (PC)**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:	**Engineering Chemistry**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course provides a fundamental understanding of the structure, properties, processing, and performance of engineering materials. It covers the relationship between atomic arrangements and material behavior, phase transformations, heat treatment processes, strengthening mechanisms, and advanced manufacturing methods such as powder metallurgy. The course also introduces composite and Nano materials, emphasizing their classification, properties, and potential engineering applications.

Course Objectives:

The course aims to:

1. Introduce the fundamental concepts of materials science, crystallography, and solid solutions.
2. Explain the interpretation of binary phase diagrams and time–temperature–transformation (TTT) diagrams.
3. Describe various heat treatment processes and their influence on microstructure and mechanical properties.
4. Discuss the mechanisms of strengthening and the principles of powder metallurgy.
5. Introduce the basic concepts, synthesis methods, and applications of composite and nano materials.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the fundamental structure–property relationship of engineering materials.	2
CO2	Interpret binary phase diagrams and TTT diagrams for steels and predict phase transformations.	3
CO3	Describe the principles and applications of various heat treatment processes.	2
CO4	Analyze strengthening mechanisms and outline the powder metallurgy process for component fabrication.	3
CO5	Discuss the basic characteristics, advantages, and applications of composite and Nano materials.	2

Course articulation matrix

COs	POs											PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO 1	3											2	2	
CO 2	3	1										2	2	
CO 3	3	1										2	2	
CO 4	3	1	2									2	2	
CO 5	3	1	2									2	2	

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (9 Hours)

INTRODUCTION TO MATERIAL SCIENCE: Material Science, Classification of materials, Mechanical properties of materials.

INTRODUCTION TO CRYSTALLOGRAPHY: Space Lattice, Unit Cell, Bravais Lattices, Coordination number, Atomic Packing Factor for SCC, BCC and FCC, Crystal imperfections, Crystal deformation- Slip and Twinning.

SOLID SOLUTIONS: Introduction, Substitutional solid solutions, Hume Rothery‘s rule, Interstitial solid solution.

Unit-II (9 Hours)

PHASE DIAGRAMS: Binary phase diagrams – Phase rule – one component system, two component system, isomorphous, eutectic, eutectoid, peritectic and peritectoid systems, Fe-Fe3C equilibrium diagram.

TTT Diagrams: TTT diagrams for eutectoid, hypo and hyper eutectoid steels.

Unit-III (9 Hours)

HEAT TREATMENT PROCESSES: Annealing, normalizing, hardening, tempering, austempering, martempering, flame Hardening, Induction Hardening & Chemical hardening techniques, hardenability concept and experimental determination.

Unit-IV (9 Hours)

STRENGTHENING MECHANISMS: Strain hardening, solid solution strengthening, grain refinement, dispersion strengthening.

POWDER METALLURGY: Powder metallurgy process, preparation of powders, Characteristics of metal powders, mixing and blending, compacting, sintering, Applications of Powder Metallurgy.

Unit-V **(9 Hours)**

COMPOSITE MATERIALS: Introduction, Classification of composites, Advantages and Dis-advantages of composite materials, applications of composite materials, various methods of component manufacture of composites – Hand Lay-up method, Resin transfer moulding, Filament winding process, and continuous pultrusion process.

NANO MATERIALS: Definition, importance of nanoscale materials, Cloassification of Nano materials (based on origin, dimensions and composition), Engineering applications of nano materials.

Text Books:

[1] Kodgirie .V.D and Kodgirie.S.V, —Material Science and Metallurgy‖, Thirty-seventh Edition, Everest House Publication, 2015.

[2] Raghavan.V, — Material Science and Metallurgy‖ ,Fifth Edition, PHI Learning Pvt Limited,2013

[3] Bhatt, Keyur D. Nanomaterials: Fundamentals, Synthesis, Characterization and Applications. 1st ed., JEC Publication, 2025

Reference Books:

[1] Avener , —Introduction to Physical Metallurgy‖, Second Edition, Tata McGraw hill Education (India) Pvt Limited,1997.

[2] Rajput R. K,—Material Science and Engineering‖, Fourth Edition, S.K.kataria& Sons,2009.

[3] C. Daniel Yesudian, D.G.Harris Samuel, —Material Science and Metallurgy‖, First Edition, SCITECH, 2006.

[4] Craig, E. Nanomaterials: An Introduction to Properties, Synthesis and Applications. 1st ed., Larsen & Keller Education, 2019.

Web Resources:

[1] Prof.R.N.Ghosh, IIT Kharagpur, Solidification Binary Alloys, Iron-Carbon Phase Diagram,[English]WebAvailable:https://www.youtube.com/results?searchquery=prof.r.n+ghosh +lecturers

[2] Prof.S.K.Gupta, IIT Delhi, Phase Diagrams, Crystal imperfections [English] Web Available: https://www.youtube.com/watch?v=x3n9ht-eRfg

24ME205 FLUID MECHANICS AND HYDRAULIC MACHINES			
Course Category:	**Program Core (PC)**	**Credits:**	**4**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-1-0**
Pre-requisites:		**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course provides a comprehensive introduction to the principles of fluid mechanics and hydraulic machines. It covers fundamental topics such as fluid properties, fluid statics, kinematics, and dynamics, the application of Bernoulli‘s and continuity equations in flow analysis. Students gain insight into pipe flow characteristics, boundary layer concepts and the impact of fluid forces on solid surfaces. The course introduces the fundamentals of turbomachinery, the study of hydraulic turbines and pumps, their classification, working principles, and performance evaluation.

Course Objectives:

- To understand the fundamental properties of fluids and the principles of fluid statics for accurate pressure measurement and analysis.
- To apply Euler‘s and Bernoulli‘s equations for fluid flow analysis and to apply the concepts of pipe flow to determine head losses.
- To illustrate the fundamentals of boundary layer theory and apply the momentum principle to study the impact of jets
- To analyze the construction, working principles and performance parameters of hydraulic turbines
- To evaluate the performance of reciprocating and centrifugal pumps

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Identify and evaluate properties of fluids and analyze fundamental fluid flow behavior	**K2**
CO2	Apply the fluid dynamics governing equations to analyze fluid flow and pipe systems	**K2**
CO3	Apply the momentum principle to interpret jet impact phenomena and analyze boundary layer behavior.	**K3**
CO4	Examine and assess the performance of Hydraulic turbines	**K3**
CO5	Analyze and evaluate the performance of reciprocating and centrifugal pumps	**K3**

Course articulation matrix

COs	POs											PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO 1	3											2		
CO 2	3											2		
CO 3	2											2		
CO 4	2											2		
CO 5	2											2		

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (12 Hours)

FLUID PROPERTIES AND FLUID STATICS: Density, Specific weight, Specific gravity, viscosity, Surface Tension, Capillarity, Types of Fluids, Vapour pressure, Compressibility, Pressure and its measurements (Treatment limited to Manometers).

FLUID KINAMETICS: Stream line, path line, streak line, stream tube, classification of flows, one and three dimensional continuity equation.

Unit-II (12 Hours)

FLUID DYNAMICS: Surface and Body forces- Euler's equation of motion and Bernoulli's equation from Euler‘s equation, applications of Bernoulli's equation.

INTRODUCTION TO PIPE FLOW: Reynolds‘s experiment, Darcy-Weisbach equation, Minor losses in pipes (Treatment limited to theory), flow through pipes in series and parallel, Hydraulic gradient and total energy lines.

Unit-III (12 Hours)

BOUNDARY LAYER CONCEPTS: Definition, Displacement Thickness, Momentum thickness, Energy thickness, Drag and Lift (Treatment limited to concept only).

INTRODUCTION TO TURBO MACHINERY: Impact of jet of water on various configurations and derivation of force applied by the jet, Introduction to velocity triangles and applications.

Unit-IV (12 Hours)

HYDRAULIC TURBINES: Impulse and reaction principles, Classification of turbines, Pelton wheel construction and working principle, Francis and Kaplan turbines detailed discussion, Heads, Efficiencies and Performance of turbines.

Unit-V (12 Hours)

HYDRAULIC PUMPS: Classification of pumps, Working Principles and work done by Centrifugal and Reciprocating pumps, Static head, Manometric head, Manometric efficiency, Net positive suction head.

Text Books:

[1] R.K. Bansal, —Fluid Mechanics & Hydraulic Machines‖ Tenth Edition, Laxmi Publications, 2023.
[2] Frank M White and Henry Xue‖, Ninth edition, Mc Graw Hill (India) Private Limited, 2021

Reference Books:

[1] P.N.Modi & S.M. Seth.,‖ Hydraulics and Fluid Mechanics‖, Second Edition, Standard Book House, 2005.
[2] R.K. Rajput,— Fluid Mechanics & Hydraulic Machines‖, Ninth Edition, S.Chand & Company, 2015.
[3] D.S.Kumar, —Fluid Mechanics & Fluid Power Engineering‖, Second Edition, S.K.Kataria & Sons Publishers, 2014.

Web Resources:

[1] Prof. S.K. Som, IIT Kharagpur, Fluid Mechanics & Hydraulic Machines, [English], Web Available: http://nptel.ac.in/courses/112105171/
[2] Prop.Gowtham Biswas, IIT Kharagpur, Fluid Mechanics & Hydraulic Machines, [English], WebAvailable: http://nptel.ac.in/courses/112104118/
[3] Fluid Mechanics & Hydraulic Machines, [English], Web Available: http://www.efluids.com/

24ME206 DYNAMICS OF MACHINERY			
Course Category:	**Program Core (PC)**	**Credits:**	**4**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-1-0**
Pre-requisites:	**24ME101 Engineering Mechanics, 24ME201 – Mechanics of Materials 24ME203- Kinematics of Machines**	**Continuous Assessment: Summative Assessment: Total Marks:**	**40 60 100**

Course Description:

This course deals with the dynamic analysis of mechanical systems that involve rotating and reciprocating parts. It introduces the concepts of turning moment diagrams, flywheels, governors, gyroscopic effects, and the balancing of machines to ensure smooth and efficient operation. The course also explores free and forced vibrations to understand the behavior of mechanical systems under oscillatory motion. Emphasis is placed on the application of theoretical principles to practical engineering problems; including power fluctuation, speed control, stability, and vibration mitigation in machinery.

Course Objectives:

By the end of this course, students will be able to:

1. Perform static and dynamic balancing of rotating masses and solve problems related to balancing of rotating and reciprocating engines.
2. Analyze the speed of different governors and describe the gyroscopic effect on moving bodies such as ships, and aircraft.
3. Construct turning moment diagrams for various engines and calculate the energy storage in flywheels.
4. Enable students to understand the fundamental principles of mechanical vibrations, and the analysis of free vibrations.
5. Develop the ability to analyze free damped and forced vibrations, understand the effects of damping, and apply concepts of magnification, isolation, and transmissibility for vibration control in engineering applications.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Accomplish balancing of rotating and reciprocating masses.	**L4**
CO2	Modulate the speed of governors and appraise gyroscopic effects on vehicles.	**L3**
CO3	Comprehend the concepts of energy fluctuations in fly wheels	**L4**
CO4	Evaluate natural frequency for free vibrations.	**L3**
CO5	Analyse the frequency of damped and forced vibrations.	**L4**

Course articulation matrix

COs	POs													
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PS O 1**	**PS O 2**	**PS O 3**
CO1	**2**	**1**										**3**	**2**	
CO2	**2**	**1**										**3**	**2**	
CO3	**2**	**1**										**3**	**2**	
CO4	**2**	**1**										**3**	**2**	
CO5	**2**	**1**										**3**	**2**	

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (12 Hours)

BALANCING OF ROTATING SYSTEMS: Introduction, Static balancing, Dynamic balancing, Transferring of a Force from one plane to another, Balancing of Several Masses in Different planes.

BALANCING OF RECIPROCATING SYSTEMS: Primary balancing only.

Unit-II (12 Hours)

GOVERNORS: Introduction, Watt Governor, Porter Governor, Hartnell Governor, Sensitiveness of a Governor, Hunting, Isochronism, Stability.

GYROSCOPES: Angular Velocity, Angular Acceleration, Gyroscopic Torque, Gyroscopic Effect on Air-planes and Naval Ships

Unit-III (12 Hours)

TURNING MOMENT DIAGRAMS: Introduction, Single - cylinder double – acting steam engine, Single - cylinder four stroke engine, Multi-cylinder engine, Fluctuation of energy, determination of maximum fluctuation of energy, coefficient of fluctuation of energy.

FLY WHEELS: Introduction, Coefficient of fluctuation of speed, energy stored in fly wheel

Unit-IV (12 Hours)

INTRODUCTION TO VIBRATION: Introduction, Definitions, Types of vibrations, Basic features of vibrating systems, Degree of freedom, free longitudinal vibrations. Transverse Vibration: Single concreted load, shaft carrying several loads, whirling of shafts. Torsional Vibration: Single rotor systems and two rotor systems, Torsionally equivalent shafts.

Unit-V (12 Hours)

DAMPED AND FORCED VIBRATIONS:

Introduction, free damped vibrations, under damped, critically damped and over damped systems, Damping Factor or Damping Ratio, Logarithmic Decrement. Forced vibrations, forced damped vibrations, Magnification factor, Vibration Isolation, Transmissibility

Text Books:

[1] S.S.Rattan, —Theory of Machines‖, Fifth edition, McGraw Hill Education (India) Private Limited, 2014

[2] Dr.R.K.Bansal & Dr.J.S.Brar,‖ Theory of Machines‖, Fourth edition, Laxmi Publications (P) Limited, 2009.

Reference Books:

[1]R.S.Khurmi & J.K.Guptha,— Theory of Machines‖, 14th Edition, S.Chand & Company, 2006.

[2] V.P.Singh,‖Mechanical vibrations‖, Second Edition, Dhanpat Rai & Co (P) Limited, 2009.

[3]Singaresu S Rao,‖Mechanical vibrations‖, Fourth Edition, Pearson/Prentice hall, 2004.

Web Resources:

[1] Video in web: http://nptel.ac.in/courses/112104114/

[2] Video in web: https://youtu.be/OlZXxPVpmBs

[3] Notes in web: http://www.vssut.ac.in/lecture_notes/lecture1429901026.pdf

24ME207 MANUFACTURING PROCESSES			
Course Category:	**Program Core (PC)**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:	**Engineering Physics & Engineering Chemistry**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

- This course provides a comprehensive study of manufacturing processes, covering traditional and modern techniques. It explores casting, welding, bulk deformation, and sheet metal operations, emphasizing principles, equipment, and defect analysis and abrasive and advanced manufacturing processes, including additive manufacturing, laser machining, and powder metallurgy.

Course Objectives:

- Perceive the fundamentals of manufacturing processes and explain the principles and operations of casting processes.
- Gain knowledge of welding and joining processes.
- Perceive bulk deformation processes.
- Describe sheet metal forming operations and explain the fundamentals of machining and finishing operations.
- Explore advanced and modern manufacturing processes.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the fundamental principles and steps involved in casting processes, including sand casting, special casting methods.	**BL2**
CO2	Demonstrate an understanding of welding processes, their classifications, working principles, advantages, limitations and applications.	**BL2**
CO3	Describe the principles of bulk deformation processes and high-energy rate forming processes.	**BL2**
CO4	Explain sheet metal operations and evaluate various abrasive machining processes including grinding, honing, lapping, and super-finishing.	**BL3**
CO5	Discuss advanced manufacturing processes such as additive manufacturing, laser machining/welding, underwater welding, sustainable manufacturing, and powder metallurgy, highlighting their advantages and applications.	**BL3**

Course articulation matrix

	POs											PSO'S		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	1	1	1		2							3	
CO2	3	1	1	1		2							3	
CO3	3	1	1	1		2							3	
CO4	3	1	1	1		2							3	
CO5	3	1	1	1		2					3		3	3

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (9 Hours)

CASTING: Introduction to Manufacturing Processes, Sand casting - General method, pattern: types, materials and allowances, Molding Sand – Materials, preparation and properties, Types of Cores, Gating system. Classification of Furnace: Constructional Features, Working Principle and Zones of Cupola Furnace, Electric Furnace – Arc. Advantages, Limitations and Applications. **Special Casting Methods:** Die Casting: Hot chamber die casting- Cold chamber die casting,

Centrifugal Casting: True Centrifugal Casting, Semi-centrifugal Casting and Centrifuging. Investment casting - Shell Mould Casting and Continuous Casting, Advantages, Limitations and Applications. Casting defects: Causes and Remedies.

Unit-II (9 Hours)

WELDING PROCESSES: Fundamentals and classification of welding, Gas welding Processes: Working Principle of Oxy-acetylene Gas Welding, Arc Welding: TIG - MIG – Arc blow, Duty cycle. Resistance Welding: Principles of Resistance Welding - Types: Butt Welding, Spot Welding, Seam Welding. Advantages, Limitations and Applications.

Special welding Processes: Electron beam welding, Thermit Welding, Electro slag welding, Friction Welding, Friction stir Welding, and Brazing & Soldering, Advantages, Limitations and Applications. Welding defects: Causes and Remedies.

Unit-III (9 Hours)

BULK DEFORMATION: Fundamentals, Hot and Cold working of metals - Rolling: Introduction, basic principles, hot rolling & cold rolling, characteristics & applications. Rolling processes & applications, operations, Equipment & roll stands - Forging- Smith forging, Drop forging, Pressing or press forging, Extrusion Process, Tube Making and Wire Drawing.

High Energy Rate Forming Processes: Explosive Forming, Electro Hydraulic Forming, Electro Magnetic Forming.

Unit-IV (9 Hours)

SHEET METAL OPERATIONS: Introduction, Types of Sheet metal operations, Spinning, deep drawing, Blanking - Punching operations. Clearance and Shear as applied to Punching/Blanking operations (simple problems), Elastic recovery in bending operation.

MACHINING PROCESSES:

Introduction, Abrasive Machining Processes: Abrasive machining, abrasives - types, Grinding wheels, Wheel mountings, Types of grinding machines, Honing, Lapping, Super Finishing, Buffing.

Unit-V (9 Hours)

ADVANCED MANUFACTURING PROCESSES:

Additive manufacturing - Introduction, General Process, Advantages, Applications.

Laser Machining and Welding: Process, Advantages and Applications,

Under Water Welding: Process, Advantages and Applications,

Sustainable Manufacturing: Introduction, Advantages and Applications, Powder Metallurgy: Introductions, Stages, Advantages and Applications.

Text Books:

[1] Production Technology (Manufacturing Processes) by P.C. Sharma, 2007, S. Chand Publishers.
[2] Manufacturing Technology by P.N. Rao,Vol.1, Edition-3, 2009, TMH.
[3] B.S. Raghuwanshi, —Workshop Technology‖, Dhanpatrai Publication, 9th Edition, 1999.

Reference Books:

[1] Welding Technology by Richard.L.Little, 1973, McGraw Hill.
[2] Degarmo, Black and Kohser, —Materials and processes in Manufacturing‖, Prentice Hall of India. 2nd Edition, 1998.

Web Resources:

[1] https://themechanicalengineering.com/casting-process.
[2] Bulk Metal Forming - an overview | ScienceDirect Topics
[3] Different Sheet Metal Operations - Mech4study
[4] https://www.nist.gov/mep/advanced-manufacturing-technology
[5] https://www.twi-global.com/technical-knowledge/faqs/faq-what-is-advanced-manufacturing

24ME208 APPLIED THERMODYNAMICS			
Course Category:	**Program Core (PC)**	**Credits:**	**4**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-1-0**
Pre-requisites:	**Basic Thermodynamics**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course provides an in-depth study of the practical applications of thermodynamic principles to various thermal systems. It focuses on the **analysis,** performance, and operation of steam boilers, steam turbines, condensers, air compressors, internal combustion engines, gas turbines, and refrigeration and air conditioning systems. The course integrates theoretical knowledge with engineering applications, **emphasizing** energy conversion processes, system efficiency, and performance optimization. It aims to equip students with the analytical and technical skills required to evaluate and design efficient thermodynamic systems used in power generation, mechanical, and refrigeration industries.

Course Objectives :

The primary objectives of this course are to:

1. Provide a comprehensive **understanding** of the principles and applications of applied thermodynamics.
2. Familiarize students with the working, classification, and performance **evaluation** of steam boilers, steam nozzles, and turbines.
3. Develop the ability to **analyze** the performance of various thermodynamic systems such as steam condensers, air compressors, internal combustion engines, and gas turbines.
4. **Enable** students to apply thermodynamic principles to refrigeration and air conditioning systems, including psychrometric analysis and comfort conditioning.
5. Build analytical and problem-solving skills to **evaluate** and improve the efficiency and performance of real-world thermal systems.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes
CO1	Analyze the performance of Staem Boilers and Steam nozzles
CO2	Analyze the working, performance of steam turbines & Steam condensers
CO3	Analyze & Evaluate the performance of Air compressors
CO4	Analyze the working & performance of I.C engines and Gas Turbines
CO5	Apply thermodynamic principles in refrigeration and air conditioning systems

Course articulation matrix

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	1	2			1							2		2
CO2	1	2			1							2		2
CO3	1	2			1							2		2
CO4	1	2			1							2		2
CO5	1	2			1							2		2

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (12 Hours)

STEAM BOILERS: Boiler sytems, Types of Boilers, Fire Tube & Water Tube Boilers, comparision, High pressure Boilers, Boiler Mountings, and Boiler Accessories.

STEAM NOZZLES: Types of nozzles, isentropic flow through nozzles, Effect of friction, Nozzle efficiency, Critical pressure ratio and maximum discharge, calculation of throat and exit areas using Mollier Diagram

Unit-II (12 Hours)

STEAM TURBINES: Types of steam turbines, Impulse turbines, velocity diagrams, pressure and velocity compounding, Reaction turbines, velocity diagrams, degree of reaction.

STEAM CONDENSERS: Jet and Surface condensers, Condenser vacuum and vacuum efficiency, Condenser efficiency, Thermodynamic analysis, Air pump.

Unit-III (12 Hours)

AIR COMPRESSORS: **Reciprocating Compressors**: Working, Effect of clearance volume, compression ratio, volumetric efficiency, indicated power, Multi-stage compressors and effect of inter-cooling, optimum intermediate pressure in a two-stage compressor.

Rotary compressors: Classification, Roots Blower, Vane Type compressor, screw compressor, Working principle of centrifugal and axial flow compressors, Comparison of reciprocating and rotary compressors, Comparison of Centrifugal and Axial compressors Applications

Unit-IV (12 Hours)

I.C.ENGINES: Working of 4-S and 2-S spark and compression ignition engines, Comparison of SI and CI engines and 4 stroke and 2 stroke engines, Applications of IC Engines, Mean effective pressure, IP, BP, Thermal and Mechanical efficiencies.,Wankel Engine

GAS TURBINES:
Ideal Brayton cycle, Open and closed cycle gas turbines, Methods for improvement of thermal efficiency of gas turbine plant, applications of gas turbines, comparison of gas turbines with IC engines and steam turbines

Unit-V (12 Hours)

REFRIGERATION: Applications of refrigeration, Methods of refrigeration, working of refrigerator and heat pump, refrigerating effect, COP, vapor compression refrigeration system, influence of various parameters on cycle performance, Refrigerant tables.

PSYCHROMETRY AND AIR CONDITIONING: Psychrometric properties, psychrometric Relations, psychrometric chart, psychrometric processes, Comfort conditions, summer and winter air conditioning systems.

Text Books:

[1] Mahesh M. Rathore —Thermal Engineering‖ Fourth Edition, Tata- McGraw-Hill, 2010
[2] R.K. Rajput —Applied thermodynamics‖, second edition, Lakshmi Publications, 2014

Reference Books:

[1] P.K. Nag —Basic and Applied Thermodynamics‖, second edition, Tata McGraw Hill, 2009
[2] C.P. Arora —Refrigeration and Air Conditioning‖ third edition, Tata McGraw Hill, 2009
[3] V Ganesan —Internal combustion engines‖ fourth edition, Tata McGraw Hill, 2017
[4] V Ganesan —Gas Turbines‖ Third edition, Tata McGraw Hill, 2010

Web Resources:

[1] Prof. T.Sundararajan, Prof. U.S.Premananda Shet and Prof. J.M.Mallikarjuna, IITMadras, Applied Thermodynamics, [English], Web
Available: http://nptel.ac.in/syllabus/112106133/
[2] Prof. Ravi Kumar, IIT Roorkee, Steam and Gas Power Systems, [English], Web
Available: http://nptel.ac.in/syllabus/112107216/
[3] Prof.M. Ramgopal, IIT Kharagpur, Refrigeration and Air Conditioning, [English], Web
Available: http://nptel.ac.in/syllabus/112105129/
[4] Dr.RaviKumar IITRoorkee, Refrigeration And Air-conditioning[English],Web
Available : https://onlinecourses.nptel.ac.in/noc18_me46/preview
Note: Use of Steam Tables, Refrigeration and Air-Conditioning Tables are permitted in Examinations

24ME282 STRENGTH OF MATERIALS & FLUID MECHANICS LABORATORY			
Course Category:	**Program Core (PC)**	**Credits:**	**1.5**
Course Type:	**Laboratory**	**Lecture-Tutorial-Practice:**	**0-0-3**
Pre-requisites:	Engineering Mechanics and Mechanics of Materials	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**60** **40** **100**

Course Description:

The Strength of Materials and Fluid Mechanics Laboratory is designed to help students understand the fundamental principles of mechanics and fluid behaviour through practical experiments.

a) ***Strength of Materials (SM) Lab:***

This section focuses on studying the mechanical properties of materials under various loading conditions. Students learn how materials respond to tension, compression, bending, torsion, and impact.

b) ***Fluid Mechanics (FM) Lab:***

This section deals with the behaviour of fluids (liquids and gases) at rest and in motion. It helps students understand flow characteristics, pressure distribution, and energy losses in pipes and channels.

Course Objectives:

To provide hands-on experience that links theoretical concepts with real-world applications in mechanical, civil, and chemical engineering systems**.**

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Determine Young‘s modulus using UTM	**K4**
CO2	Evaluate hardness, Tensile, compressive, shear and impact strengths as per IS code of Practice	**K4**
CO3	Measure the rigidity modulus by conducting torsion test on Mild Steel	**K4**
CO4	Determine the coefficient of discharge for Venturimeter, orifice, Orificemeter & Mouthpiece	**K4**
CO5	Determine the Friction factor for a given pipe	**K4**
CO6	Evaluate and analyze the characteristics of Centrifugal pumps, Reciprocating Pumps and Gear pumps	**K4**

Course articulation matrix

	POs											PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	**2**			**3**								**1**	**2**	
CO2	**2**			**3**								**1**	**2**	
CO3	**2**			**3**								**1**	**2**	
CO4	**2**			**3**								**1**	**2**	
CO5	**2**			**3**								**1**	**2**	
CO6	**2**			**3**								**1**	**2**	

(1-Low, 2 -Medium, 3–High)

Course Content

Strength of Materials Lab:

1. Determination of Young‘s modulus for Mild Steel by conducting Tension test on UTM
2. Load vs Deflection - Determination of Young's modulus on cantilever beam and simply supported beam.
3. Compression test- Determination of compressive strength of Concrete block or Wood
4. (a) Rockwell Hardness test and (b) Brinnell's Hardness Test - Determination of Hardness Number for different metal specimens such as Mild steel, cast iron, Brass, Aluminum.
5. Impact Test - (a) Charpy and (b) lzod: Determination of impact strength of Mild steel and cast iron specimens
6. Torsion test - Determination of Modulus of Rigidity of the material.
7. Double shear Test - Determination of shear strength of Mild steel specimens

Fluid Mechanics Lab:

8. Orifice / mouthpiece - Determination of coefficient of discharge
9. Venturimeter / Orifice meter - Determination of coefficient of discharge
10. Pipe friction - Determination of friction factor and size of roughness of a given pipe.
11. Single - stage centrifugal pump - To draw the operating characteristics of the pump and to determine the designed discharge and designed head from it.
12. Single - acting reciprocating pump - To draw the operating characteristic curves at constant speed and determination of efficiency.
13. Gear pump - To draw the operating characteristic curves and determination of overall efficiency
14. Reynold‘s Experiment / Verification of Bernouli‘s Equation

Text Books & References:

[1] James M. Gere and Barry J. Goodno, —Mechanics of Materials‖ Seventh edition, CENGAGE Learning, 2019

[2] R.K.Bansal, —Fluid Mechanics & Hydraulic Machines‖ Fifth edition, Laxmi Publishers, 2020

[3] Dr. Sadhu Singh,‖Strength of Materials‖ Ninth edition, Khanna Publishers, 2017.

[4] P.N.Modi & S.M. Seth.,‖Hydraulics and Fluid Mechanics‖, Second edition, Standard Book House, 2015.

24ME283
MANUFACTURING PROCESSES LABORATORY

Course Category:	**Program Core (PC)**	**Credits:**	**1.5**
Course Type:	**Laboratory**	**Lecture-Tutorial-Practice:**	**0-0-3**
Pre-requisites:	Manufacturing Processes	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**60** **40** **100**

Course Description: This laboratory course provides hands-on experience with fundamental and advanced manufacturing processes used in modern industry. Students will perform experiments and projects involving fitting, casting, welding, 3D Printing, and other key production methods. Emphasis is placed on understanding the principles, capabilities, limitations, and quality aspects of each process. Through practical exercises, students will learn to operate manufacturing tools, equipment and to evaluate product quality. The course integrates safety training, teamwork, and technical documentation to prepare students for real-world manufacturing environments.

Course Objectives:

The course is designed to provide students with practical exposure to fundamental manufacturing processes including fitting, welding, foundry, and 3D printing.

It focuses on developing essential fabrication skills, ensuring safe workshop practices, and maintaining quality standards.

Students will also enhance their teamwork and problem-solving abilities through laboratory exercises and apply their learning in a mini-project involving component fabrication and assembly.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Develop various joints using fitting.	**K3**
CO2	Apply suitable welding techniques to join materials	**K3**
CO3	Build various sand casting moulds.	**K3**
CO4	Construct various models using 3D printing.	**K3**
CO5	Integrate different manufacturing processes to complete a mini-project, demonstrating teamwork, safety, and effective documentation.	**K6**

Course articulation matrix

COs	POs											PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO 1	1		1	3								1	1	1
CO 2	3		1	3								1	1	1
CO 3	3		1	3								1	1	1
CO 4	3		3	3								3	3	3
CO 5	3		3	3					3			3	3	3

(1-Low, 2 -Medium, 3–High)

Course Content

I. FITTING:

To make the following joints

a. Half round Joint

b. Stepped Joint

c. Dovetail Joint

II .WELDING:

To make the following welding joints

a. To make Lap Joint using Oxy Acetylene Gas welding

b. To make _T'– Joint using MIG welding

c. To make Spot joint (Door Handle) using Resistance welding

III. FOUNDRY:

To make the following sand moulds

a. Single piece pattern (Stepped Rectangular Block)

b. Two piece pattern (Step Cone Pulley)

c. Two piece pattern (Double end pipe flange)

IV. 3D PRINTING:

To make the following 3D print models

a. Bolt &Nut

b. Screw feeder

c. Gear wheel

V. PROJECT:

To prepare a metal Casting (Automobile component) – Group assignment

Text Books:

[1] S.K.HajraChowdary, A.K. HajraChowdary, NirjharRoy,‖Elements of Workshop Technology, Vol.I‖.Media Promoters and Publishers Pvt.Ltd, Mumbai,Scitech Publications, Chennai, 2013

Web Resources:

[1] https://www.youtube.com/watch?v=OwzHpVE_S4I

[2] https://www.youtube.com/watch?v=1nXbYXj7Xos

[3] https://www.youtube.com/watch?v=0tOfaQ9pOGU

[4] https://www.youtube.com/watch?v=wQaytFTckGU

[5] https://3d-p.eu/wp-content/uploads/2018/08/IO3_3DP-courseware_EN.pdf

24EN281 ENGLISH FOR PROFESSIONALS			
Course Category:	**HS**	**Credits:**	**1**
Course Type:	**LAB**	**Lecture-Tutorial-Practice:**	**0-0-2**
Pre-requisites:	**Intermediate English**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**60** **40** **100**

Course Description:

English for Professionals course covers functional English grammar, elocution, extempore speaking, short story writing, storytelling, debating, vocabulary building, biographical sketches, the Versant test, blog writing, etiquette, team building, and leadership. It emphasizes practical exercises, voice modulation, articulation, quick thinking, effective communication, cultural importance, and developing an online presence and confidence in professional settings. This comprehensive curriculum aims to enhance students' linguistic abilities, interpersonal skills, and leadership qualities for success in diverse professional environments.

Course Objectives:

1) Explain the fundamentals of language in terms of grammar & lexical resource in communication.
2) Familiarize listening and speaking while communicating with others.
3) Introduce language skills, Etiquettes, Team Building and Leadership in professional and social contexts with clarity and accuracy.
4) Teach coherence, cohesion and precision in formal written communication.
5) Illustrate grammar and vocabulary by introducing versant test.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Recall the fundamentals of language in terms of grammar and lexical resource in communication	K1
CO2	Understand how to listen, reflect and speak while communicating with others.	K2
CO3	Apply language skills, Etiquettes, Team Building and Leadership in professional and social contexts with clarity and accuracy.	K3
CO4	Analyze ideas with coherence, cohesion and precision in formal written communication.	K4
CO5	Evaluate grammar and vocabulary using Versant Test.	K5

Course articulation matrix

	POs										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2							2	3		2
CO2	2							2	3		2
CO3	2							2	3		2
CO4	2							2	3		2
CO5	2							2	3		2

(1-Low, 2 -Medium, 3–High)

Course Content
Unit-I **Functional English Grammar** Modal Verbs – Subject-Verb Agreement – Active & Passive Voice – Reported Speech – Question Tags – Practice Exercises. (2 Hours)
Unit-II **Elocution** Define – Discuss the Importance – Key Components – Voice Modulation – Articulation – Posture and Gestures – Practice. (2 Hours)
Unit-III **Extempore** Introduction – Significance – Developing Quick Thinking – Communication Skills – Confidence –Strategies for Effective Speaking – Practice. (2 Hours)
Unit-IV **Story Telling** Definition – Narratives through Spoken Words – Gestures and Expressions – Importance of Culture – Story Telling Techniques – Vocal Modulation – Pacing – Gestures and Facial Expressions – Practice. (2 Hours)
Unit-V **Debate** Introduction – Understanding the Structure – Purpose of a Debate – Developing Basic Debating skills – Do's and Don'ts – Practice. (2 Hours)
Unit-VI **Team Building & Leadership** Team Building traits: Forming – Storming – Norming – Performing – Adjourning. Leadership traits: Vision – Integrity – Decisiveness – Confidence – Empathy – Flexibility – Innovation. (2 Hours)
Unit-VII **Corporate Etiquette** Social Etiquette – Business Etiquette – Telephone Etiquette – Dining Etiquette – Summary. (2 Hours)
Unit-VIII **Short Story Writing** Introduction – Key Characteristics – Brevity – Theme – Types – Creating Relatable Characters. (2 Hours)
Unit-IX **Blog Writing** Introduction – Purpose in Digital World – Different types of Blogs – Benefits – Building Online Presence – Sharing Knowledge – Connecting with Others. (2 Hours)
Unit-X **Biographical Sketch** Purpose – Overview of Person's Life – Key Events – Conclusion. (2 Hours)
UNIT – XI: **Vocabulary** Idiomatic Expressions – Idioms with Body Parts – Animal Idioms – Colour Idioms – Phrasal Verbs – One-word Substitutes – Analogies – Practice. (2 Hours)

UNIT – XII:

Versant Test

Overview of the Versant Test – Purpose and Importance – Format of the Test – Types of Questions – Practice. (2 Hours)

Lab Manual

1) English for Professionals Lab Manual

References:

1) Wren & Martin. (2023). *English Grammar and Composition.* S. Chand & Company.
2) Dale Carnegie. (2016). *The Quick and Easy way to Effective Speaking.* Rupa Publications,
3) Richard A. Spears. (2005). *McGraw-Hill's Dictionary of American Idioms and Phrasal Verbs.*McGraw Hill.
4) Jon M. Ericson, James J. Murphy, Raymond Bud Zeuschner. (2003). *The Debater's Guide.*(Third Edition). Southern Illinois University Press, Carbondale.
5) S. P. Dhanavel. (2010). *English and Soft Skills.* Orient Blackswan.
6) Barun K. Mitra. (2011). *Personality Development and Soft Skills.* Oxford University Press.

Web Resources:

1) https://www.pearson.com/languages/hr-professionals/versant.htmlSoftx

AI Tools

1) Grammar and Syntax Mastery: Wordvice, Bussu
2) Speaking Fluency and Clarity: Forvo, ELSA Speak
3) Communication Strategies: Speechace, Rosetta Stone
4) Story Telling Techniques: Plot Generator, Narrativa
5) Vocabulary Acquisition: Quizlet, Anki
6) Writing Proficiency: EAngel, Scribens, Grammarly

4/12/25

Head
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24UC202
PROFESSIONAL ETHICS

Course Category:	**Mandatory course (MC)**	**Credits:**	**0**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**2-0-0**
Pre-requisites:	**---**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**100** **---** **100**

Course Description:

Through this course, students are exposed to ethical principles, professional responsibilities, and social dimensions of engineering practice. It emphasizes moral reasoning, ethical decision-making, and the development of professional integrity in engineering contexts. Through case studies and theoretical frameworks, students explore the ethical challenges engineers face in technology development, safety, environmental sustainability, and global practice.

Course Objectives:

1. To understand the scope and significance of engineering ethics and moral values in professional life.
2. To develop skills for analyzing moral dilemmas and applying ethical theories to real-world engineering problems.
3. To recognize the importance of professional responsibility, safety, rights, and risk management in engineering projects.
4. To gain awareness of global and societal issues, including environmental and computer ethics, intellectual property, and corporate responsibility.
5. To understand the basic principles of contract management and the legal framework governing engineering practice.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the moral and ethical theories related to engineering practice.	K2
CO2	Apply ethical reasoning for professional dilemmas and responsibilities.	K3
CO3	Analyze case studies to evaluate ethical decision-making and safety practices.	K4
CO4	Assess global and environmental issues affecting engineering ethics.	K4
CO5	Apply and interpret the principles of the Indian Contract Act in professional contexts.	K3

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	2	-	-	-	-	-	3	-	-	-	-	1	-	-
CO2	-	-	-	-	3	-	3	-	-	-	-	1	-	-

CO3	-	-	**3**	-	-	**3**	**3**	-	-	-	-	1	-	-
CO4	-	-	-	-	-	-	**3**	-	-	**2**	**2**	**1**	-	-
CO5	-	-	-	-	-	-	**3**	-	-	**2**	-	1	-	-

Course articulation matrix

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (6 Hours)

Engineering Ethics: Senses of 'Engineering Ethics', variety of moral issues, types of inquiry, moral dilemmas, moral autonomy : Kohlberg's theory ;Gilligan's theory, consensus and controversy, Models of Professional Roles, Theories about right action, Self-interest- customs and religion, Use of ethical theories.

Unit-II (6 Hours)

Engineering as Social Experimentation: Engineering as experimentation, Learning from past, Engineers as responsible experimenters, Codes of ethics, A balanced outlook on law, The challenger disaster a case study.

Unit-III (6 Hours)

Safety, Responsibilities and Rights: Safety and risk, Assessment of safety and risk, Risk benefit analysis, reducing risk, The three mile island and Chernobyl case studies, Collegiality and loyalty, Respect for authority, Collective bargaining, Confidentiality, Conflicts of interest, Occupational crimes, Professional rights, Employee rights, Intellectual Property Rights (IPR), Discrimination.

Unit-IV (6 Hours)

Global Issues: Multinational corporations, Environmental ethics, Computer ethics, Weapons development, Engineers as managers, Engineers as Professionals, Managing Conflicts, Consulting engineers, Engineers as expert witnesses and advisors, Moral leadership, Sample code of Ethics (Specific to a particular Engineering Discipline).

Unit-V (6 Hours)

General principles of contracts management: Indian contract act, Contract, Essential elements of a valid contract, Types of contract – valid contract; invalid contract; other types of contracts, Offer – types of offer; legal rules for offer, Acceptance – legal rules for acceptance, Consideration – legal rules as to consideration, Stanger to contract, Capacity to contract.

Text Books:

1. Mike Martin and Roland Schinzinger, —Ethics in engineering‖, McGraw Hill, New York (1996).
2. Govindarajan M, Natarajan S, Senthil Kumar V. S., —Engineering Ethics‖, Prentice Hall of India, New Delhi (2004).

Reference Books:

1. Baum, R.J. and Flores, A., —Ethical Problems in Engineering, Center for the study of the Human Dimensions of Science and Technology‖, Rensellae Polytechnic Institute, Troy, New York, 335 pp. eds. (1978)
2. Beabout, G.R., Wennemann, D.J., —Applied Professional Ethics: A Developmental Approach for Use with Case Studies‖, University Press of America Lanham, MD, 175 pp (1994).

3. Dutt(1994) Indian Contract Act, Eastern Law House.

Web Resources:

- https://www.scribd.com/document/552528071/professional-development-with-applied-ethics-module-1-docx
- https://grace.unodc.org/grace/uploads/documents/academics/Integrity_and_Ethics_Module_14_Professional_Ethics.pdf
- https://onlineethics.org/cases/three-mile-island-nuclear-accident
- https://www.tutorialspoint.com/engineering_ethics/index.htm
- https://www.slideshare.net/slideshow/indian-contract-act-1872-14444088/14444088

V SEMESTER

24ME301 HEAT TRANSFER			
Course Category:	**Program Core (PC)**	**Credits:**	**4**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-1-0**
Pre-requisites:	**Basic Thermodynamics** **Fluid Mechanics** **Numerical Mathematics**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description: This course introduces fundamental heat transfer modes including conduction, convection, boiling, condensation, and radiation. It covers analysis of fins, transient heat transfer, and heat exchangers. The course also explores thermal system applications and introduces machine learning techniques for solving modern heat transfer engineering problems and enhancing predictive thermal analysis capabilities.

Course Objectives:

- To understand the fundamentals of heat conduction in thermal systems with and without heat generation.
- To study fins, transient heat conduction, and forced convection heat transfer mechanisms.
- To learn free convection, boiling, and condensation processes in engineering applications. the design and performance of heat exchangers
- To analyze the energy exchange between surfaces by radiation heat transfer.
- To introduce machine learning techniques and their applications in heat transfer engineering.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Apply heat conduction principles for steady with and without heat generation in thermal systems.	**K3**
CO2	Analyze fins, transient conduction, and forced convection heat transfer problems.	**K3**
CO3	Evaluate free convection, understand boiling, and condensation heat transfer phenomena effectively and design of heat exchangers.	**K3**
CO4	Analyze thermal radiation heat exchange between surfaces.	**K3**
CO5	Apply machine learning techniques in solving modern heat transfer engineering problems.	**K3**

Course articulation matrix

	POs											PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**		**2**	**2**								**2**	**1**	
CO2	**3**		**2**	**3**								**2**	**1**	
CO3	**2**		**3**	**2**								**2**	**1**	
CO4	**2**		**3**	**2**								**2**	**1**	
CO5	**2**		**3**	**3**								**2**	**1**	

(1-Low, 2 -Medium, 3–High)

Course Content

UNIT-I (12 Hours)

Introduction: Modes and basic laws of heat transfer, Fourier equation, thermal resistance, electrical analogy thermal conductivity of materials, Derivation of general heat conduction equation in Cartesian and cylindrical coordinate system, initial and boundary conditions.

Steady State Conduction: 1-D Steady state heat Conduction through single and multi-layer walls (Plates, and cylindrical walls), Uniform heat generation - plane wall and cylinder and critical thickness of insulation.

UNIT-II (12 Hours)

Heat transfer from extended surfaces: Temperature distribution and heat transfer from an infinitely long fin, short fins (insulated at the tip, convection at the tip), fin efficiency and effectiveness.

Transient Heat Conduction: Transient heat transfer in lumped capacity systems, time constant and significance of Boit's Number.

Forced Convection: Convective heat transfer coefficient, boundary Layer concept, and empirical relations for solving problems of forced convection over a flat plate and cylinder, analogy between momentum and energy transfer.

UNIT-III (12 Hours)

Free Convection: Free convection problems in external flows (vertical & horizontal plates and cylinders) using empirical relations.

Boiling and Condensation: Concept of pool boiling (Nukiyama's boiling curve) & flow boiling regimes, drop-wise and film-wise condensation.

Heat Exchangers: Classification of heat exchangers, performance analysis, and overall heat transfer coefficient, fouling factor, LMTD approach, and effectiveness and NTU approach (Parallel & Counter flow).

UNIT-IV (12 Hours)

Radiation - Processes and properties: Introduction, absorptivity, reflectivity and transmissivity, concept of Black body, spectral and spatial energy distribution, Plank's law, Stefan Boltzmann law, Wien's displacement law, Kirchhoff's law.

Radiation Exchange between surfaces: Shape factor and its properties, shape factor of simple geometries, Heat exchange between black and gray bodies infinite parallel plates and concentric cylinders, small gray bodies using electrical network approach and radiation shields.

UNIT-V (12 Hours)

Machine Learning in Heat Transfer –

Physics versus data methods: Physics and data in heat transfer, Artificial intelligence and machine learning, Common algorithms in machine learning.

Neural networks for heat transfer: The learning paradigm, Linear regression, Neural networks, Practical considerations in engineering problems, Applications in heat transfer.

Text Books:

[1] lncropera and Dewitt, —Principles of Heat and Mass Transfer‖, John Wiley, 2013.
[2] C. Balaji, Balaji Srinivasan, Sateesh. G, —Heat Transfer Engineering: Fundamentals And Techniques‖, Academic Press, 2020.
[3] S.K.Som, —Introduction to Heat transfer‖, PHI, 2013.
[4] P. K. Nag, —Heat and Mass Transfer‖, Tata McGraw Hill, 2011.
[5] J. P. Holman, —Heat Transfer‖, Tata McGraw Hill, 2008.

Reference Books:

[6] R.C. Sachdeva, —Fundamentals of Engineering Heat and Mass Transfer‖, New Age Internationals, 2017.
[7] N. Ozisik, —Heat Transfer - A Basic Approach‖, TMH, 1985.
[8] R. K. Rajput, —Heat and Mass Transfer‖, S Chand & Company Ltd, 2012.
[9] D. S. Kumar, —Heat & Mass Transfer‖, S. K. Kataria & Sons, 2015.

Web Resources:

[10] IIT video lecturers (NPTEL): https://nptel.ac.in/courses/112101097/
[11] https://www.grc.nasa.gov/www/k-12/airplane/heat.html
[12] http://study.com/academy/lesson/heat-transfer-phase-changes.html
https://www.tes.com/teaching-resource/heat-transfer-convection-11810446

NOTE: Heat and Mass Transfer Data Book is allowed in the examinations.

24ME302 DESIGN OF MACHINE ELEMENTS			
Course Category:	**Program Core (PC)**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:	• Engineering Mechanics • Strength of Materials • Kinematics of Machines	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course introduces the fundamental concepts and methodologies involved in the design of machine elements subjected to various types of loading conditions. It emphasizes failure theories, design against static and dynamic loads, and the design of commonly used mechanical components such as shafts, keys, couplings, springs, fasteners, and bearings. The course integrates analytical, empirical, and standard design procedures with real-world applications.

Course Objectives:

- To understand the fundamentals of machine design and failure theories.
- To apply design principles for static and dynamic loading conditions.
- To design mechanical elements such as shafts, keys, couplings, and fasteners.
- To Analyze and design springs and bearings used in mechanical systems.
- To develop the ability to use design data books and standards for practical applications.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Apply theories of failure and factor of safety concepts for designing machine elements subjected to static loading conditions.	K3
CO2	Apply fatigue failure criteria and design principles for machine elements subjected to fluctuating loading conditions	K3
CO3	Analyze and design bolted and riveted joints subjected to different loading conditions.	K4
CO4	Analyze and design power screws and welded joints considering strength and loading conditions.	K4
CO5	Design helical and leaf springs subjected to static and fluctuating loading conditions.	K4

Course articulation matrix

	POs											PSOs		
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	2	1	2									
CO2	3	3	3	2	2									
CO3	3	3	2	2	2									
CO4	3	2	2	1	2									
CO5	3	3	3	2	3									

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (9 Hours)

Fundamentals of Machine Design

Basics:

Introduction to design process – General considerations in machine design – Selection of materials - Phases of Design, Types of Designs, Standardization in Design, Preferred Numbers and their Significance

Design for Static Strength:

Simple Stresses - Combined Stresses - Torsion and Bending - Stresses - Stress Strain Relation, Various Theories of Failure - Factor of Safety and its Importance – Design for static loading.

Unit-II (9 Hours)

Fatigue Strength Fundamentals:

Stress Concentration - Theoretical Stress Concentration Factor - Fatigue Stress Concentration Factor - Fatigue Strength - Factors affecting fatigue strength - Endurance Limit - Design for Fluctuating Stresses

Fatigue Failure Criteria:

Gerber's Parabolic Relation - Goodman Line - Soderberg Line - Modified Goodman Diagram - Fatigue Design under Combined Stresses

Unit-III (9 Hours)

Riveted joints:

Types of Riveted Joints, Terminology, Failures of a Riveted Joint, Efficiency of a Riveted Joint, Design of Lap and Butt Riveted Joints, Design of Boiler Joints, Lozenge Joint, and Design of Riveted Joints under Eccentric Loading.

Bolted joints:

Design of Bolted Joints under Eccentric Loading – Eccentric Load acting Parallel to axis of Bolts, Eccentric Load acting Perpendicular to the Axis of Bolts, and Eccentric Load acting in the Plane Containing the Bolts.

Unit-IV (9 Hours)

Power Screws:

Types - Mechanics of Power Screws, Efficiency, Self-Locking of Screw and Stresses in Screw.

Welded joints:

Terminology, Types of Welded Joints, Advantages and Disadvantages, Strength of Butt and Fillet joints - Design of Eccentrically Loaded Welded Joints - Stresses induced on the joint be of different nature (Case-1) and of the same nature (Case-2).

Unit-V (9 Hours)

Design of springs:

Types of Springs – Stress and Deflection in Helical Springs – Spring Materials - Design of Helical springs against Static and Fluctuating Loads

Leaf springs :

Construction of Leaf springs – Multi Leaf Springs – Nipping of Leaf Springs – Materials for Leaf Springs.

Text Books:

1. Bhandari, V.B., *Design of Machine Elements*, McGraw Hill Education.
2. Shigley, J.E., *Mechanical Engineering Design*, McGraw Hill Education.

Reference Books:

[1] R.S Khurmi & J.K. Gupta, —A Text book of Machine Design‖ Fourteenth Edition, S.Chand &Co. Ltd.
[2] Robert L.Norton, —Machine Design- An Integrated Approach‖, Fifth Edition, Pearson Education.
[3] P. Kannaiah, —Machine Design‖, Second Edition, SciTech Publications Private Limited.

****DATA BOOKS TO BE ALLOWED IN EXAMINATION****

[1] Mahadevan & Balaveera Reddy, —Design data book‖, - CBS Publishers

[2] V.B.Bhandari, —Design data book‖, Tata McGraw Hill book Co
[3] Design data book, P.S.G. College of Technology, Coimbatore

Web Resources:

1. http://nptel.ac.in/courses/112/105/112105124/
2. http://nptel.ac.in/courses/112/105/112105125/
3. http://nptel.ac.in/courses/112/106/112106137/
4. https://nptel.ac.in
5. https://ocw.mit.edu

24ME303
Robotics

Course Category:	**Program Core (PC)**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture – Tutorial – Practice:**	**3-0-0**
Pre-requisites:	**Manufacturing Technology, Kinematics**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course introduces the fundamentals of industrial robotics, including robot anatomy, classifications, and applications in automation. It covers robotic end effectors, sensors, machine vision systems, and robot drive mechanisms used in industrial environments. The course explains robot programming methods, control systems, and kinematic analysis for robotic motion. It also introduces coordinate transformations, Denavit–Hartenberg representation, and trajectory planning concepts. In addition, the course highlights the integration of artificial intelligence with robotics for modern industrial applications.

Course Objectives:

The course aims to:

1. To provide fundamental knowledge of robot structure, components, classifications, and industrial applications.
2. To familiarize students with robotic end effectors, sensors, and machine vision systems used in automation.
3. To develop understanding of robot drive systems, control methods, and robot programming techniques.
4. To introduce kinematic analysis, coordinate transformations, and trajectory planning in robotic systems.
5. To explain the integration of artificial intelligence with robotics for modern industrial applications.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Describe the structure, anatomy, classifications, end effectors, and applications of industrial robots.	K2
CO2	Explain various robotic sensors, sensory devices, and machine vision systems used in robotic automation.	K2
CO3	Explain the working principles of robot drive systems, control systems, and robot programming methods.	K2
CO4	Apply kinematic concepts, homogeneous transformations, forward and inverse kinematics, and trajectory planning techniques in robotic systems.	K4
CO5	Explain the integration of artificial intelligence techniques in modern robotic and industrial automation applications.	K3

Course articulation matrix

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO 1	3	2	1	-	-	-	-	-	-	-	-	2	2	2
CO 2	3	2	2	-	-	-	-	-	-	-	-	2	2	2
CO 3	3	2	1	-	-	-	-	-	-	-	-	2	2	2
CO 4	3	3	2	-	-	-	-	-	-	-	-	2	2	2
CO 5	2	2	1	-	-	-	-	-	-	-	-	2	2	2

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (9 Hours)

Introduction: Robotics, Robot Anatomy, Degrees of freedom, Work volume, Robot Components, Classification of robots by coordinate system and control system, Precision of movement, specification of robots, Economic Considerations, Fixed versus flexible automation, Applications of robots.

Robot End Effectors: Introduction, End effector, Types of end effectors, Grippers – Mechanical grippers, Vacuum cups, Magnetic grippers, Adhesive grippers, Hooks, scoops and other miscellaneous devices, Tools as end effectors, Robot/End effector interface, considerations in the selection and design.

Unit-II (9 Hours)

Robotic Sensory Devices: Introduction, Non-optical position sensors – potentiometers, Linear Variable Differential Transformers, optical position sensors – opto interrupters, optical encoders (absolute & incremental).

Proximity Sensors: Contact type, Non-contact type – reflected light scanning laser sensors.

Touch & Slip Sensors: Tactile sensors – proximity rod & photo detector sensors, slip sensors – Forced oscillation slip sensor, interrupted type slip sensors

Machine Vision: Introduction, Functions of machine vision, applications of machine vision.

Unit-III (9 Hours)

Robot Drives and Control Systems: Introduction, Functions of drive systems, Hydraulic drive systems – hydraulic actuators, advantages and disadvantages, Pneumatic drive systems – pneumatic actuators, advantages and disadvantages, Electric drive systems – DC servo motors, AC servo motors and stepper motors.

Robot Programming: Introduction, Methods of robot programming, Lead-through programming, Walk-through programming, Off-line programming, Robot programming languages, Motion interpolation – linear and circular interpolation.

Unit-IV (9 Hours)

Transformations and Kinematics: Objectives, Forward and inverse kinematics, homogenous coordinates, basic transformation operations, forward solution – Denavit Hartenberg procedure, Inverse Kinematics – Direct approach, Geometric approach. Simple problems involving homogeneous transformations as applicable to rotation and translation.

Introduction to Trajectory Planning, Steps in Trajectory planning and manipulator jacobian

Unit-V (9 Hours)

Integration of AI and Robotics: Introduction, the Five Levels of Autonomy in Robots, Case Studies in AI-Based Robotics: Predictive Maintenance, Autonomous Mobile Robots, Quality Inspection, Precision Agriculture.

Text Books:

1. Robotic Engineering by Richard D.Klafter, Prentice Hall, Tata Mc Graw-Hill, 1995. 3rd Edition.

2. Mikell P. Groover, Industrial Robotics: Technology, Programming, and Applications, Tata McGraw-Hill Education, 1st Edition, 2008.

Reference Books:

1. International Federation of Robotics (IFR), Artificial Intelligence in Robotics – Position Paper, IFR Publications, 2022.

2. Introduction to Robotics – John J. Craig, Addison Wesley,3rd Edition

3. Robotics – K. S. Fu, Gonzalez & Lee, Tata Mc Graw-Hill, 1995. 3rd Edition.

4. Robotics for Engineers by Yoram Koren. Tata Mc Graw-Hill, 1995. 3rd Edition.

Web Resources:

1. https://onlinecourses.nptel.ac.in/noc21_me32/preview?utm_source=chatgpt.com

2. https://youtube.com/playlist?list=PLyqSpQzTE6M_XM9cvjLLO_Azt1FkgPhpH&si=5oSi-FfEcKg1AEIy

3. https://youtu.be/AsxvuSTXhbw?si=IA5N1W_KX80d0tjp

24ME360A SYSTEMS ENGINEERING			
Course Category:	**Inter Disciplinary Elective**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:	**NIL**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course introduces the fundamental principles and practices of Systems Engineering, focusing on the interdisciplinary approach used to design, develop, integrate, manage, and sustain complex systems throughout their life cycle. The course covers systems thinking, systems engineering processes, life cycle models, project management integration, requirements engineering, system architecture, model-based systems engineering (MBSE), trade-off analysis, system integration, verification and validation, and operational support. Students will gain knowledge of modern systems engineering methodologies, standards, modeling techniques, and management practices used in industrial, defense, aerospace, manufacturing, IT, and infrastructure systems.

Course Objectives:

Students are expected to study,

1. The principles of systems thinking, systems engineering processes, and international systems engineering standards.
2. System life cycle models and applies project management concepts such as risk management, WBS, and SEMP in systems engineering projects.
3. Stakeholder requirements and design system architectures using functional and physical design approaches.
4. Model-based systems engineering (MBSE), trade-off analysis, modeling, and simulation techniques for system design and evaluation.
5. System integration, verification, validation, operation, maintenance, and retirement activities for complex engineered systems.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Understand systems thinking concepts, systems engineering processes, life cycle models, and relevant industry standards for complex systems development.	**K2**
CO2	Apply systems engineering management principles including risk management, work breakdown structures, project planning, and stakeholder coordination in system development projects.	**K3**
CO3	Analyze stakeholder needs and develop functional, performance, and interface requirements for system architecture design.	**K4**
CO4	Understand MBSE concepts, modeling tools, trade-off analysis, and	**K2**

	simulation techniques to evaluate and optimize system designs for reliability, safety, and maintainability.	
CO5	Apply system integration, verification, validation, testing, operation, maintenance, and transition activities across the system life cycle.	**K3**

Course articulation matrix

	POs											PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**	**1**	**2**	**1**	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**2**	**2**
CO2	**2**	**2**	**2**	**1**	**2**	**1**	**1**	**2**	**3**	**2**	**3**	**2**	**2**	**3**
CO3	**2**	**3**	**3**	**2**	**2**	**1**	**1**	**2**	**2**	**3**	**2**	**3**	**3**	**2**
CO4	**2**	**2**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**2**	**2**	**3**	**3**	**1**
CO5	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**3**	**3**

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (9 Hours)

Introduction to Systems Engineering:

Systems Thinking: Definitions of systems, system hierarchies, complexity, and emergent behavior.

The Systems Engineering Process: Overview of the Vee model, technical management processes, and engineering design loops.

Systems Engineering Standards: Introduction to industry standards (e.g., ISO/IEC/IEEE 15288).

Unit-II (9 Hours)

System Life Cycle and Management:

Life Cycle Models: Waterfall, V-model, Spiral, and Agile systems engineering.

Project Management Integration: Risk management, work breakdown structure (WBS), and Systems Engineering Management Plan (SEMP).

Organization and Leadership: Roles of stakeholders, team structure, and decision-making in technical management.

Unit-III (9 Hours)

System Requirements and Architecture:

Stakeholder Needs Definition: Identifying user needs and operational scenarios.

Requirements Engineering: Analysis, development, and management of functional and performance requirements.

System Architecture Design: Functional architecture, physical design, and interface

management.

Unit-IV (9 Hours)

Design, Analysis, and Modeling:

Model-Based Systems Engineering (MBSE): Introduction to modeling languages and tools (e.g., SysML).

Trade-off Analysis: Trade-space exploration, modeling, simulation, and optimization.

System Robustness: Designing for reliability, safety, and maintainability.

Unit-V (9 Hours)

System Integration, Validation, and Operation:

Verification and Validation (V&V): Ensuring the system works and is the correct system.

Integration and Test: Components, subsystem, and system-level testing.

Transition and Operation: Logistics, maintenance, and system retirement.

Text Books:

1. Systems Engineering Principle and Practice , Alexander Kossiakoff, Samuel J. Seymour, David A. Flanigan, Steven M. Biemer, John Wiley & Sons, Inc., 3rd Edition, 2020.

Reference Books:

1. Systems Engineering Fundamentals and Applications, Reinhard Haberfellner, Olivier de Weck Ernst Fricke, Siegfried Vössner, Springer Nature Switzerland AG 2019.

2. NASA Systems Engineering Handbook, National Aeronautics and Space Administration NASA Headquarters Washington, D.C. 20546 December 2007.

3. Systems Engineering: Design Principle and Models, Dahai Liu, CRC Press Taylor & Francis Group, 2016.

4. Systems Engineering Guidebook-A process for developing systems and Products, James N Martin, CRC Press, 2000.

Web Resources:

1. **https://science.nasa.gov/toolkit/systems-engineering-tutorial**
2. **https://www.nasa.gov/reference/systems-engineering-handbook**
3. **https://ocw.mit.edu/courses/16-842-fundamentals-of-systems-engineering-fall-2015**
4. **https://www.sebokwiki.org**

24ME360B **Sustainable Energy Technologies**			
Course Category:	**Inter Disciplinary Elective**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:	**Engineering Thermodynamics**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course aims to provide fundamental knowledge of renewable energy resources and technologies. It enables students to understand the principles, components, and applications of solar, wind, biomass, geothermal, and other renewable energy systems, while emphasizing sustainable energy development, environmental benefits, energy conversion processes, storage technologies, and integration of renewable energy for reliable power generation.

Course Objectives:

This course provides basic knowledge of renewable energy resources and technologies. It helps students understand the principles, components, and applications of solar, wind, biomass, and geothermal energy systems, while highlighting sustainable energy development, environmental benefits, energy conversion methods, storage technologies, and the integration of renewable energy for reliable power generation.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the fundamentals of renewable energy resources and their role in sustainable energy systems.	k2
CO2	Describe the principles and components of wind energy conversion systems and their performance.	k2
CO3	Analyze solar photovoltaic and solar thermal energy systems and their applications.	k4
CO4	Explain the working principles of biomass, geothermal and small hydropower energy systems.	K3
CO5	Explain emerging renewable energy technologies such as tidal, wave, hydrogen energy, fuel cells, and hybrid energy systems.	K3

Course articulation matrix

	POs											PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**				**2**					**1**	**2**		
CO2	**3**	**2**			**1**	**2**						**2**	**2**	
CO3	**3**	**2**	**1**		**2**	**2**						**2**	**2**	**2**
CO4	**3**	**2**				**2**						**2**	**2**	
CO5	**2**	**2**			**1**	**2**					**1**	**1**		**2**

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (9 Hours)

Renewable Energy (RE) Fundamentals: Introduction to Renewable Energy (RE), Current conventional and RE contributions in India and the worldwide, Environmental problems caused by fossil fuels.

Renewable Energy Resources and Performance: solar energy, wind energy, hydroelectric power, biomass energy, and geothermal energy, Renewable Energy Resource Assessment Energy Conversion Principles, Introduction to sustainable energy systems and Key performance indicators.

Unit-II (9 Hours)

Solar Resource and Thermal Applications:

Solar Radiation and Solar Geometry, Radiation Measurement, Solar Thermal Power Plants, Thermal Energy Storage Systems using Phase Change Materials (PCM)

Solar Photovoltaic Systems:

Basic Principle of SPV Conversion, Types of Solar Cells, Photovoltaic Cell Concepts (Cell, Module, Array), PV Module I–V Characteristics, Series and Parallel Connections, Types of PV Systems, Maximum Power Point Tracking (MPPT), Applications of Solar Photovoltaic Systems.

Unit-III (9 Hours)

Wind Energy Systems

Introduction to wind energy systems, wind characteristics and resource assessment, wind power estimation and Betz limit, types and components of wind turbines, turbine control methods, wind energy conversion systems, Hydropower Resource Assessment.

Small Hydropower Systems

Introduction to Hydropower, Mini and Micro Hydropower Systems, Classification of Hydropower Schemes, Classification of Water Turbines, Turbine Theory(Working principle), Essential Components of Hydroelectric Systems.

Unit-IV (9 Hours)

Biomass Energy Systems:

Introduction to Biomass Energy, Biomass Resources, Energy from Biomass and Conversion Processes, Biogas and Biofuels, Biomass Cogeneration, Environmental Benefits of Biomass Energy.

Geothermal Energy Systems:

Geothermal Resources and Exploration, Direct Use of Geothermal Energy, Geothermal Electricity Generation, Environmental Aspects of Geothermal Energy.

Unit-V (9 Hours)

Ocean Energy Systems :

Tidal Energy: Energy from Tides, Barrage and Non-Barrage Tidal Power Systems, Wave Energy: Energy from Waves and Wave Power Devices, Ocean Thermal Energy Conversion (OTEC), Ocean Energy Challenges

Hydrogen Energy Systems:

Hydrogen Production methods and Storage technologies , Fuel Cells basics and Applications, Energy Storage Systems, Hybrid Energy Systems, Future trends in renewable energy, Challenges associated with RE storage.

Text Books:

Twidell, J. and Weir, T., *Renewable Energy Resources*, Routledge Publications.
Boyle, G., *Renewable Energy: Power for a Sustainable Future*, Oxford University Press.
Khan, B.H., *Non-Conventional Energy Resources*, McGraw Hill Education.

Reference Books:

Duffie, J.A. and Beckman, W.A., *Solar Engineering of Thermal Processes*, Wiley.
Manwell, J.F., McGowan, J.G., and Rogers, A.L., *Wind Energy Explained*, Wiley.
Rai, G.D., *Non-Conventional Energy Sources*, Khanna Publishers.

Web Resources:

https://mnre.gov.in (Ministry of New and Renewable Energy – India)
https://www.irena.org (International Renewable Energy Agency)
https://www.iea.org (International Energy Agency)
https://nptel.ac.in (NPTEL Renewable Energy Courses)

24ME360C MANUFACTURING TECHNOLOGY			
Course Category:	**Inter Disciplinary Elective**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:	**Nil**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course introduces the fundamental manufacturing processes used in modern industries for product development and fabrication. It covers casting, welding, machining, sheet metal operations, and numerical control systems used in manufacturing. The course also explains unconventional manufacturing processes, powder metallurgy, and additive manufacturing technologies. Students gain knowledge of manufacturing principles, process selection, and industrial applications. The course emphasizes both conventional and advanced manufacturing methods used in modern production industries.

Course Objectives:

- To understand the principles and applications of various casting and welding processes used in manufacturing industries.
- To explain the working principles and operations of conventional and unconventional machining processes.
- To develop knowledge of numerical control systems used in production.
- To introduce advanced manufacturing techniques such as additive manufacturing.
- To familiarize students with modern manufacturing technologies and their industrial applications.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the classification of manufacturing processes, engineering materials, and various casting methods used in manufacturing industries.	K2
CO2	Describe different welding processes, welding defects, inspection methods, and their industrial applications.	K2
CO3	Explain the working principles and operations of conventional machining processes and CNC machines.	K2
CO4	Discuss additive manufacturing processes, 3D printing technologies, materials, and their industrial applications.	K2
CO5	Explain the principles, working mechanisms, advantages, limitations, and applications of unconventional manufacturing processes.	K3

Course articulation matrix

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO1	3	1	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	1	1	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	3	-	-
CO4	3	2	1	-	-	-	-	-	-	-	-	3	2	2
CO5	3	2	1	-	-	-	-	-	-	-	-	3	3	3

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (9 Hours)

Introduction to Manufacturing Technology:

Classification of manufacturing processes, Selection of manufacturing processes, Introduction to engineering materials – classification and selection.

Manufacturing by Melting (Casting):

Principle of casting, Pattern materials and allowances, Types of patterns, Moulding sand properties, Sand moulding process, Core making, Melting furnaces, Casting defects and remedies, Special casting processes – Die casting, Investment casting and Centrifugal casting.

Unit-II(9 Hours)

Manufacturing by Joining (Welding):

Principles of welding, Classification of welding processes, Gas welding, Arc welding, Resistance welding, TIG welding, MIG welding, Soldering and Brazing, Welding defects and inspection methods, Safety precautions in welding, Applications of welding processes.

UNIT-III (9 Hours)

Subtractive Manufacturing:

Working principles and operations of Lathe, Drilling, Milling and Grinding machines. Cutting tools, Cutting fluids, Machining parameters, Introduction to CNC machines, Advantages and applications of CNC machining.

Unit-IV (9 Hours)

Additive Manufacturing:

Introduction to Additive Manufacturing, Classification of additive manufacturing processes, 3D printing technologies – FDM, SLA, SLS, Materials used in additive manufacturing, Process steps, Advantages, limitations and industrial applications.

Unit-V (9 Hours)

Unconventional Manufacturing Methods:

Introduction and need for unconventional machining, Abrasive Jet Machining (AJM), Ultrasonic Machining (USM), Electric Discharge Machining (EDM), Electro Chemical Machining (ECM), Laser Beam Machining (LBM), Plasma Arc Machining (PAM), Advantages, limitations and applications of unconventional machining processes.

Text Books:

[1] Production Technology (Manufacturing Processes) by P.C. Sharma, 2007, S. Chand Publishers.
[2] Manufacturing Technology by P.N. Rao,Vol.1, Edition-3, 2009, TMH.
[3] B.S. Raghuwanshi, —Workshop Technology‖, Dhanpatrai Publication, 9th Edition, 1999.

Reference Books:

[1] Welding Technology by Richard.L.Little, 1973, McGraw Hill.

[2] Degarmo, Black and Kohser, —Materials and processes in Manufacturing‖, Prentice Hall of India. 2nd Edition, 1998.

Web Resources:

[1] https://themechanicalengineering.com/casting-process.
[2] https://www.nist.gov/mep/advanced-manufacturing-technology
[3] https://www.twi-global.com/technical-knowledge/faqs/faq-what-is-advanced-manufacturing

24ME310C
ADDITIVE MANUFACTURING

Course Category:	**Program Elective**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:	Manufacturing Processes, CAD	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

Additive Manufacturing introduces the fundamental principles, processes, materials and applications of layer-by-layer manufacturing technologies used for rapid prototyping and direct digital manufacturing. The course covers various Additive Manufacturing systems including liquid-based, extrusion-based, powder bed fusion and directed energy deposition processes. It also focuses on Design for Additive Manufacturing (DfAM), rapid tooling, post-processing techniques, AM data formats and software tools. The course enables students to understand the capabilities, limitations and industrial applications of Additive Manufacturing technologies in aerospace, automotive, biomedical and tooling sectors.

Course Objectives:

- Understand the fundamentals, classifications, materials and process chain involved in Additive Manufacturing technologies.
- Explain the working principles, process characteristics, advantages and limitations of various Additive Manufacturing systems.
- Analyze powder bed fusion and directed energy deposition processes used in metal additive manufacturing.
- Apply Design for Additive Manufacturing (DfAM), rapid tooling and post-processing concepts in engineering applications.
- Understand AM data formats, software tools and industrial applications of Additive Manufacturing in modern manufacturing sectors.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the historical development, process chain, classification, materials, advantages and limitations of Additive Manufacturing processes and compare them with conventional manufacturing methods.	K2
CO2	Describe the working principles, process characteristics, applications, advantages and limitations of liquid-based and extrusion-based Additive Manufacturing systems such as SLA, DLP, Material Jetting and FDM.	K2
CO3	Analyze the principles, applications and material considerations of Powder Bed Fusion and Directed Energy Deposition processes including SLS, SLM, EBM and WAAM.	K4
CO4	Apply Design for Additive Manufacturing (DfAM), rapid tooling and post-processing concepts for the fabrication and quality improvement of AM components.	K3
CO5	Describe AM data formats, AM software tools, preprocessing techniques and evaluate industrial applications and recent trends in Additive Manufacturing technologies.	K2

Course articulation matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	1	1	-
CO2	2	2	1	-	-	-	-	-	-	-	-	2	2	-
CO3	3	2	2	-	-	-	-	-	-	-	-	2	2	1
CO4	2	2	2	-	-	-	-	-	-	-	-	2	2	2
CO5	2	2	1	-	-	-	-	-	-	-	-	2	2	2

(1-Low, 2 -2Medium, 3–High)

Course Content

Unit-I (9 Hours)

Introduction to Additive Manufacturing

Introduction to Additive Manufacturing (AM) – Definition, historical development, advantages, limitations of AM. Additive Manufacturing process chain and classification of AM processes according to ASTM standards.

Prototyping fundamentals – Types and roles of prototypes. Comparison of Additive Manufacturing with conventional manufacturing and CNC machining. Materials for AM – Polymers, photopolymers, thermoplastics, metal powders and ceramics.

Unit-II (9 Hours)

Liquid-Based and Extrusion-Based Additive Manufacturing Systems

Liquid-based AM systems – Principle, process parameters, applications, advantages and limitations of: Stereo lithography Apparatus (SLA), Digital Light Processing (DLP), Material Jetting

Extrusion-based AM systems – Principle, process parameters, applications, advantages and limitations of Fused Deposition Modelling (FDM).

Unit-III (9 Hours)

Powder Bed Fusion and Directed Energy Deposition Systems

Powder Bed Fusion systems – Principle, process, applications, advantages and limitations of: Selective Laser Sintering (SLS), Selective Laser Melting (SLM), Electron Beam Melting (EBM)

Directed Energy Deposition (DED) systems – Principle, process and applications of powder-fed

and wire-fed DED systems including Wire Arc Additive Manufacturing (WAAM). Metal additive manufacturing challenges – residual stresses, porosity and anisotropy.

Unit-IV (9 Hours)

Design for Additive Manufacturing, Rapid Tooling and Post-processing

Design for Additive Manufacturing (DfAM) – Core DfAM Concepts and Objectives, support structure generation, and part orientation. Rapid Tooling – Introduction, classification and applications. Indirect rapid tooling processes and direct rapid tooling processes.

Post-processing techniques – Support removal, heat treatment, surface finishing and machining of Additive Manufacturing parts.

Unit-V (9 Hours)

Additive Manufacturing Data Formats and Software

AM data formats: STL format, STL file problems, STL repair, AMF (Additive Manufacturing File Format) and OBJ file format. AM software: pre-processing techniques, slicing software and build preparation.

Applications of Additive Manufacturing in aerospace industry, automotive industry, biomedical applications, tooling applications, jewelry and consumer products.

Text Books:

1. Gibson, I., Rosen, D., & Stucker, B., 'Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing', 3rd Edition, Springer, 2021.
2. Chua C.K., Leong K.F, LIMC.S, —Rapid Prototyping: Principles and Applications, World Scientific publications, 3rd Edition, 2010.

Reference Books:

1. Paul F Jacobs, —Rapid Prototyping& Manufacturing, Wohlers Associates, 2000 ASME Press, 1st Edition, 1996.
2. D.T Pham, S. S. Dimov, —Rapid Manufacturing, Springer, 1st Edition, 2001.
3. ASTM F42 committee standards on Additive Manufacturing.

Web Resources:

1. https://wohlersassociates.com/terminology-and-definitions/materials-for-am/

24ME310A **Renewable Energy Systems**			
Course Category:	**Program Elective**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:	**Engineering Thermodynamics**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course aims to provide fundamental knowledge of renewable energy resources and technologies. It enables students to understand the principles, components, and applications of solar, wind, biomass, geothermal, and other renewable energy systems, while emphasizing sustainable energy development, environmental benefits, energy conversion processes, storage technologies, and integration of renewable energy for reliable power generation.

Course Objectives:

This course provides basic knowledge of renewable energy resources and technologies. It helps students understand the principles, components, and applications of solar, wind, biomass, and geothermal energy systems, while highlighting sustainable energy development, environmental benefits, energy conversion methods, storage technologies, and the integration of renewable energy for reliable power generation.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the fundamentals of renewable energy resources and their role in sustainable energy systems.	K2
CO2	Describe the principles and components of wind energy conversion systems and their performance.	K2
CO3	Analyze solar photovoltaic and solar thermal energy systems and their applications.	K4
CO4	Explain the working principles of biomass, geothermal and small hydropower energy systems.	K3
CO5	Explain emerging renewable energy technologies such as tidal, wave, hydrogen energy, fuel cells, and hybrid energy systems.	K3

Course articulation matrix

	POs											PSOs		
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**2**				**2**					**1**	**2**		
CO2	**3**	**2**			**1**	**2**						**2**	**2**	
CO3	**3**	**2**	**1**		**2**	**2**						**2**	**2**	**2**
CO4	**3**	**2**				**2**						**2**	**2**	
CO5	**2**	**2**			**1**	**2**					**1**	**1**		**2**

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (9 Hours)

Renewable Energy (RE) Fundamentals: Introduction to Renewable Energy (RE), Current conventional and RE contributions in India and the worldwide, Environmental problems caused by fossil fuels.

Renewable Energy Resources and Performance: solar energy, wind energy, hydroelectric power, biomass energy, and geothermal energy, Renewable Energy Resource Assessment Energy Conversion Principles, Introduction to sustainable energy systems and Key performance indicators.

Unit-II (9 Hours)

Solar Resource and Thermal Applications:

Solar Radiation and Solar Geometry, Radiation Measurement, Solar Thermal Power Plants, Thermal Energy Storage Systems using Phase Change Materials (PCM)

Solar Photovoltaic Systems:

Basic Principle of SPV Conversion, Types of Solar Cells, Photovoltaic Cell Concepts (Cell, Module, Array), PV Module I–V Characteristics, Series and Parallel Connections, Types of PV Systems, Maximum Power Point Tracking (MPPT), Applications of Solar Photovoltaic Systems.

Unit-III (9 Hours)

Wind Energy Systems

Introduction to wind energy systems, wind characteristics and resource assessment, wind power estimation and Betz limit, types and components of wind turbines, turbine control methods, wind energy conversion systems, Hydropower Resource Assessment.

Small Hydropower Systems

Introduction to Hydropower, Mini and Micro Hydropower Systems, Classification of Hydropower Schemes, Classification of Water Turbines, Turbine Theory(Working principle), Essential Components of Hydroelectric Systems.

Unit-IV (9 Hours)

Biomass Energy Systems:

Introduction to Biomass Energy, Biomass Resources, Energy from Biomass and Conversion Processes, Biogas and Biofuels, Biomass Cogeneration, Environmental Benefits of Biomass Energy.

Geothermal Energy Systems:

Geothermal Resources and Exploration, Direct Use of Geothermal Energy, Geothermal Electricity Generation, Environmental Aspects of Geothermal Energy.

Unit-V (9 Hours)

Ocean Energy Systems :

Tidal Energy: Energy from Tides, Barrage and Non-Barrage Tidal Power Systems, Wave Energy: Energy from Waves and Wave Power Devices, Ocean Thermal Energy Conversion (OTEC), Ocean Energy Challenges

Hydrogen Energy Systems:

Hydrogen Production methods and Storage technologies , Fuel Cells basics and Applications, Energy Storage Systems, Hybrid Energy Systems, Future trends in renewable energy, Challenges associated with RE storage.

Text Books:

Twidell, J. and Weir, T., *Renewable Energy Resources*, Routledge Publications.
Boyle, G., *Renewable Energy: Power for a Sustainable Future*, Oxford University Press.
Khan, B.H., *Non-Conventional Energy Resources*, McGraw Hill Education.

Reference Books:

Duffie, J.A. and Beckman, W.A., *Solar Engineering of Thermal Processes*, Wiley.
Manwell, J.F., McGowan, J.G., and Rogers, A.L., *Wind Energy Explained*, Wiley.
Rai, G.D., *Non-Conventional Energy Sources*, Khanna Publishers.

Web Resources:

https://mnre.gov.in (Ministry of New and Renewable Energy – India)
https://www.irena.org (International Renewable Energy Agency)
https://www.iea.org (International Energy Agency)
https://nptel.ac.in (NPTEL Renewable Energy Courses)

24ME310B CONTROL SYSTEMS & MECHATRONICS			
Course Category:	**Program Elective**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:		**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

Mechatronics Engineering is an interdisciplinary program that integrates mechanical, electrical, electronics, computer, and control engineering to design intelligent and automated systems for industrial, robotics, and technological applications

Course Objectives:

- Understand the working principles of various Sensors and Transducers and Develop system models & transfer function for Mechanical, Electrical, Fluid &Thermal systems.
- Gain knowledge about different controllers such as Proportional, Derivative, Integral, PI, PD and PID.
- Understand PLC basic structure, I/O, processing, programming, develop ladder diagrams and Analyze various case studies related to Mechatronics systems

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Understand the working principles of various Sensors and Transducers.	**K2**
CO2	Develop system models & transfer function for Mechanical, Electrical, Fluid &Thermal systems.	**K3**
CO3	Compare different controllers such as Proportional, Derivative, Integral, PI, PD and PID	**K2**
CO4	Understand basic structure, I/O, processing, programming, and develop ladder diagrams	**K3**
CO5	Analyze various case studies related to Mechatronics systems	**K4**

Course articulation matrix

COs	POs											PSOs		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PSO 1	PSO 2	PSO 3
CO 1	3	3			2				2				2	
CO 2	2	2			2				2				2	
CO 3	2	2			2				2				2	
CO 4	3	2			2				2				2	
CO 5	3	3			3				3				3	

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (9 Hours)

Introduction to Mechatronics: Introduction to embedded systems, the design process, traditional and mechatronics designs, Sensors & Transducers: Introduction, performance terminology, sensors - potentiometer sensor, strain gauged element, Capacity element, LVDT, Optical Encoders and Tacho-generator, Selection of sensors.

Signal Conditioning: Introduction data acquisition – Quantizing theory, Analog to digital conversion, digital to analog conversion.

Unit-II (9 Hours)

Basic System Models: Modeling of one and two degrees of freedom Mechanical, Electrical, Fluid and thermal systems. Block diagram representations for these systems.

Actuation systems: Hydraulic and pneumatic systems, directional control valves, valve actuation symbols, Pressure control valves, single and double action cylinders, cylinder sequencing.

Unit-III (9 Hours)

Closed loop controllers: Continuous and discrete processes, control modes, Two-step, Proportional, Derivative, Integral, PID controllers.

Digital logic: Logic gates, Applications of logic gates: digital comparator, coder. SR flip-flop.

Unit-IV (9 Hours)

PLC : Introduction, basic structure, I/O, processing, programming, ladder diagrams, Latching and internal relays, sequencing , timers, internal relays and counters, data handling, analogue input and output, selection of PLC.

Basic Ladder Diagrams: Start/Stop (Seal-in or Latching) Circuit, Basic AND, Or, NOT Logic circuits, Timer ON Delay (TON) Circuit. Timer OFF Delay (TOF) Circuit, Retentive Timer (RTO) Circuit, Counter Up (CTU) Circuit, Counter Down (CTD) Circuit, ,Counter Reset Logic

Unit-V (9 Hours)

PLC applications: Ladder diagrams and explanation for Motor Control with Interlock, Blinking Lamp Circuit, Set/Reset (Latch/Unlatch) Coil Logic, Alarm/Trip Logic, Level Control (Tank Fill/Drain), Emergency Stop (E-Stop) Circuit

Design: Designing Mechatronics systems, possible design solutions, case studies of Mechatronics systems – i) Pick and place robot ii) Car park barriers iii) Bar code- reader

Text Books:

[1] Mechatronics: Electronic control systems in Mechanical and Electrical Engineering by W. Bolton, PEARSON , 6th Edition, 2015.

[2] Introduction to Mechatronics – David and Alcaitore Michael B.Histand TMH, 4th Edition, 2006.

Reference Books:

[1] Mechatronics by N P Mahalik,1st Edition, 2003, TMH.

[2] Mechatronics System design by Devdas Shetty and Richard A Kolk, Cengage Learning, 2nd edition.

Web Resources:

[1] www.engr.colostate.edu/~dga/mechatronics/resources.html

[2] www.NI.com/

[3] www.cambridgemechatronics.com/

[4] www.pdf-free-download.com/mechatronics-labs.pdf

24ME310D PRODUCTION PLANNING AND CONTROL			
Course Category:	**Program Elective**	**Credits:**	**3**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**3-0-0**
Pre-requisites:	**NIL**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**40** **60** **100**

Course Description:

This course provides an overview of Production Planning and Control (PPC) concepts used in manufacturing and operations management. It covers forecasting techniques, material requirements planning (MRP), scheduling methods, Just-in-Time (JIT) systems, aggregate planning, product and process planning, factory physics, and Theory of Constraints (TOC). The course emphasizes efficient resource utilization, production optimization, and modern manufacturing strategies for improving productivity and competitiveness.

Course Objectives:

Students are expected to study,

- To provide knowledge of production systems, production planning and control hierarchy, product design, and demand forecasting techniques used in manufacturing organizations.
- To develop understanding of inventory control systems, dependent demand concepts, and Material Requirements Planning (MRP) for effective materials management.
- To familiarize students with manufacturing scheduling methods, sequencing techniques, and Just-in-Time (JIT) production systems for improving operational efficiency.
- To impart knowledge on aggregate planning, master production scheduling, product planning, and process planning for effective production management.
- To introduce concepts of factory physics, variability, push–pull systems, CONWIP, and Theory of Constraints (TOC) for enhancing productivity and system performance.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Understand the evolution of production systems, PPC hierarchy, product design concepts, and apply various demand forecasting techniques for production decision-making.	**K3**
CO2	Analyze inventory control systems and apply Material Requirements Planning (MRP) concepts for effective materials management and production planning.	**K4**
CO3	Apply scheduling and sequencing techniques in manufacturing systems and evaluate the principles and strategic implications of Just-in-Time (JIT) production systems.	**K4**
CO4	Develop aggregate plans, master production schedules, and analyze product planning and process planning techniques for efficient manufacturing operations.	**K3**
CO5	Differentiate factory dynamics, variability, push–pull systems, CONWIP, and apply Theory of Constraints (TOC) concepts for improving production and operational performance.	**K4**

Course articulation matrix

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1		1						2	3	2	1
CO2	3	3	2	1	2						2	3	3	1
CO3	2	3	2	1	2				1	1	2	2	3	2
CO4	2	3	3	2	2				1	1	3	3	3	2
CO5	2	3	2	2	2		1		1		3	2	3	3

(1-Low, 2 -Medium, 3–High)

Course Content

Unit-I (9 Hours)

Introduction: Milestones in the evolution of production systems, Overview of Production Planning and Control Hierarchy, product design.

Forecasting Methods: Demand Forecasting: Principles and Methods, Judgment methods, Causal methods, Time-series methods.

Unit-II (9 Hours)

Material Requirements Planning: Review of EOQ and Inventory control systems, Concept of Dependent Demand; Structure of MRP system, MRP Calculations, Planning Issues, Implementation Issues.

Aggregate Planning: Purpose & Methods, Reactive and Aggressive Alternatives, Planning Strategies, LP Formulation, Master Production Scheduling.

Unit-III (9 Hours)

Scheduling: Scheduling in Manufacturing, Sequencing Operations for One Machine, Sequencing Operations for a two-station Flow Shop, Job Shop Dispatching.

Just in Time Production Systems: Evolution, Characteristics of JIT Systems: Small lot production, Stable MPS, Kanban System, Continuous Improvement, TPM, Strategic Implications of JIT System.

Unit-IV (9 Hours)

Product planning: Product planning-Extending the original product information-Value analysis-Problems in lack of product planning.

Process planning: Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system.

Unit-V (9 Hours)

Factory Physics: Basic factory dynamics, Variability basics, Push and pull production systems, CONWIP.

Theory of Constraints: TOC and Drum-Buffer-Rope, TOC process as applied to Marketing, Production and Project Management.

Text Books:

1 L.J. Krajewski and L.P Ritzmen, Operations Management: Strategy and Analysis, Pearson Education, 2021, 13th Edition.

2.Baffa & RakeshSarin, "Modern Production/Operations Management", 8th Edition, John Wiley & Sons, 2002.

Reference Books:

1. James. B. Dilworth, ‖Operations management – Design, Planning and Control for manufacturing and services‖ Mcgraw Hill International edition 1992.

2. MartandTelsang, —Industrial Engineering and Production Management‖, First edition, S. Chand and Company, 2000.

3. Jain. K.C. & Aggarwal. L.N., —Production Planning Control and Industrial Management‖, Khanna Publishers, 1990.

Web Resources:

1. https://mrcet.com/downloads/digital_notes/ME/IV%20year/PPC%20NOTES.pdf
2. https://khannapublishers.in/system/storage/download/Sec_7_Chap_36_38_Industrial_Engineering_Production_Management_SCSharma.pdf.JBBaKDsgHy3Y5OISHlG9VgZ4d8iYmqou
3. https://biet.ac.in/pdfs/Mech-PRODUCTION%20PLANNING%20AND%20CONTROL.pdf

24ME383

HEAT TRANSFER LABORATORY

Course Category:	Program Core (PC)	Credits:	1.5
Course Type:	Laboratory	Lecture-Tutorial-Practice:	0-0-3
Pre-requisites:	Basic Thermodynamics Fluid Mechanics	Continuous Assessment: Summative Assessment: Total Marks:	60 40 100

Description: These experiments explore fundamental heat transfer modes—conduction, convection, and radiation—and their engineering applications. Thermal conductivity is measured for metals and insulating powders, while lagged pipe studies highlight insulation effectiveness. Fin and duct experiments demonstrate forced convection, and natural convection over cylinders explains buoyancy effects. Heat exchangers compare parallel, counter, and cross-flow performance. Radiation experiments determine the Stefan–Boltzmann constant and emissivity. Refrigeration and air conditioning systems are evaluated using COP. Transient heat conduction examines time-dependent behavior.

Course Outcomes:

At the end of the course, student will be able to

CO1: Explain and apply the principles of conduction, convection, and radiation in analyzing heat transfer through solids, fluids, and surfaces. (K2)

CO2: Experimentally determine thermal properties such as thermal conductivity, emissivity, and radiative constants using standard heat transfer apparatus.(K3)

CO3: Analyze and evaluate heat transfer performance in fins, ducts, and insulated systems under steady-state conditions.(K4)

CO4: Assess the effectiveness and performance of different heat exchangers, including parallel flow, counter flow, and cross-flow configurations.(K4)

CO5: Evaluate the performance of refrigeration and air conditioning systems by determining the coefficient of performance (COP) and related operating parameters. (K5)

Contribution of Course Outcomes towards the achievement of Program Outcomes

PO	1	2	3	4	5	6	7	8	9	10	11	PSO I	PSO II	PSO III
CO 1	3	2										2	1	
CO 2	3	3		2	2							3	2	
CO 3	3	3	2	2	2							3	2	1
CO 4	3	2	2	2	2							3	2	1
CO5	3	2	2	2								3	2	1

(1-Low, 2-Medium, 3-High)

Experiments:

1. Measurement and Calibration of Temperature Using a Thermocouple
2. Measurement of Thermal conductivity of metal rod
3. Measurement of Thermal conductivity of insulating powder
4. Heat transfer through a lagged pipe apparatus
5. Heat transfer from pin fin in forced convection
6. Heat transfer by forced convection through a duct
7. Heat transfer by natural convection over a cylindrical surface

8. Heat transfer in Parallel flow and Counter flow heat exchangers
9. Heat transfer in Cross flow heat exchanger
10. Determination of Stefan Boltzmann constant
11. Measurement of Emissivity of a Grey surface
12. Determination of COP of Vapour compression refrigeration system
13. Determination of COP of an Air conditioning system

NOTE: Heat and Mass Transfer Data Book is allowed in the examination.

Text Books:

[1] lncropera and Dewitt, —Principles of Heat and Mass Transfer‖, John Wiley, 2013.
[2] S.K.Som, Introduction to Heat transfer, PHI, 2013.
[3] Arora, R.C., Refrigeration and air conditioning. PHI, 2012.

24ME384

MACHINE TOOLS and METROLOGY LABORATORY

Course Category:	**Program Core (PC)**	**Credits:**	**1.5**
Course Type:	**Laboratory**	**Lecture-Tutorial-Practice:**	**0-0-3**
Pre-requisites:	**Manufacturing Process**	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**60** **40** **100**

Course Description:

This course provides hands-on experience in conventional machining and precision metrology. In the first part, students develop practical skills in operating lathe, milling, drilling, shaping, and slotting machines to create components with specific geometries and keyways. The second part focuses on Metrology, where students learn to use precision instruments like sine bars, profile projectors, and tool makers' microscopes to evaluate dimensional accuracy, tool geometry, and surface integrity.

Course Outcomes:

Upon successful Completion of the course, the student will be able to:

CO1: Perform basic lathe and drilling operations to produce components. [K3]
CO2: Execute complex machining operations on milling, shaping, and slotting machines. [K3]
CO3: Apply centerless grinding techniques to achieve precise cylindrical finishes. [K3]
CO4: Measure tapers and angles accurately using sine bars, slip gauges, and spheres. [K4]
CO5: Evaluate threads, tool geometry, and surface texture using metrology instruments. [K5]

Contribution of Course Outcomes towards achievement of Program Outcomes

	POs											**PSO'S**		
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	**3**		**3**	**3**	**3**								**3**	
CO2	**3**		**3**	**3**	**3**								**3**	
CO3	**3**		**3**	**3**	**3**								**3**	
CO4	**3**		**3**	**3**	**3**								**3**	
	3			**3**	**3**								**3**	

(1-Low, 2-Medium, 3-High)

Part-A: MACHINE TOOLS

List of Experiments:

1. Lathe:

- To perform various lathe operations such as plain turning, step turning, taper turning, knurling, and thread cutting.

2. Drilling:

- To perform drilling, reaming, counter-boring, and counter-sinking on a drilling machine.

3. Milling:

- To perform various milling operations such as external key-way cutting, as well as concave and convex milling.

4. Shaping:

- To perform plain shaping, external keyway cutting, and step cutting on a shaping machine.

5. Slotting:

- To perform internal and external keyway cutting using a slotting machine.

6. Centerless grinding Machine

To perform grinding of cylindrical workpieces using a centerless grinding machine.

Part-B: Metrology Lab

1. Measurement of External Taper by Using Roller and Slip Gauges
2. Measurement of unknown angle using Sine Bar
3. Measurement of Internal Taper of Tapered Bore Gauge by using Spheres and Rollers
4. Measurement of Various Elements of External Thread by using Three Wire Method
5. Measurement of the basic dimensions of the given Standard Screw with Profile Projector
6. Measurement of the diameter of the wire and Tool Signature of the given Single Point Cutting Tool using Tool Makers Microscope
7. Measurement of Surface texture parameters (Ra,Rq & Rz) of a given Product

Text Books:

[1] S.K.HajraChowdary, A.K. HajraChowdary, NirjharRoy,‖Elements of Workshop Technology, Vol.II‖.Media Promoters and Publishers Pvt.Ltd, Mumbai,Scitech Publications, Chennai, 2013

[2] Mahajan, M. A Textbook of Metrology**,** Dhanpat Rai & Co. (2015).

24ME382 PLC & AUTOMATION LABORATORY			
Course Category:	**Program Core (PC)**	**Credits:**	**1**
Course Type:	**Laboratory**	**Lecture-Tutorial - Practice:**	**0 - 0 - 2**
Pre-requisites:	Manufacturing Processes	**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**60** **40** **100**

Course Description:

This laboratory course introduces students to the fundamentals of industrial automation and Programmable Logic Controllers (PLCs). The course provides hands-on experience in PLC programming using ladder logic diagrams for implementing industrial control applications such as logic operations, timers, counters, motor control, water level control, pneumatic systems, and material handling automation. Students will gain practical knowledge in designing, testing, and troubleshooting automation systems used in modern manufacturing industries.

Course Objectives:

The course aims to:

1. To understand the basic architecture and operation of Programmable Logic Controllers (PLCs).
2. To develop PLC ladder logic programs for industrial automation applications.
3. To implement timers, counters, relays, and sequential control operations using PLCs.
4. To design and test automation systems for real-time industrial processes.
5. To provide practical exposure to industrial control and automation techniques.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Explain the basic structure, operation, and programming concepts of PLCs.	K2
CO2	Develop ladder logic programs using logic gates, relays, timers, and counters.	K3
CO3	Implement PLC-based control systems for industrial automation applications.	K3
CO4	Analyze and troubleshoot PLC-controlled systems used in manufacturing environments.	K4
CO5	Design simple industrial automation systems using PLC programming techniques.	K5

Course articulation matrix

COs	POs											PSOs		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2										2	2	2
CO2	3	2										2	2	2
CO3	3	2										2	2	2
CO4	3	2										2	2	2
CO5	3	2										2	2	2

(1-Low, 2-Medium, 3-High)

Course Content

List of experiments:

1. Introduction to PLC and Basic PLC Structure
2. Implementation of logic gates using PLC ladder diagram (LD)
3. Implementation of Latching and internal Relay using PLC
4. Implementation of timers using PLC
5. Implementation of counters using PLC
6. Automatic Door control system using PLC
7. Automatic Water Level control using PLC
8. Motor speed control using PLC
9. Automation of material handling system using PLC
10. Automatic pneumatic stamping machine using PLC
11. Traffic Light Automation using PLC
12. Smart Agriculture Based Automation using PLC

Text Books:

1. Programmable Logic Controllers, Frank D. Petruzella, McGraw Hill Education, 5th Edition.
2. Programmable Logic Controllers: Principles and Applications, PHI Learning.
3. Automation, Production Systems and Computer Integrated Manufacturing, Pearson Education.

Reference Books:

1. Introduction to Programmable Logic Controllers, Delmar Cengage Learning.
2. Industrial Automation and Robotics, Laxmi Publications.

Web Resources:

1. Siemens PLC Learning Portal
2. Allen Bradley PLC Tutorials
3. PLC Programming Tutorials by AutomationDirect
4. NPTEL – Industrial Automation and Control
5. PLC Basics and Ladder Logic Tutorials

24UC302 Environmental Science			
Course Category:	**Mandatory course (MC)**	**Credits:**	**0**
Course Type:	**Theory**	**Lecture-Tutorial-Practice:**	**2-0-0**
Pre-requisites:		**Continuous Assessment:** **Summative Assessment:** **Total Marks:**	**100** **-** **100**

Course Description:

The course is designed for B.Tech. Learners, providing essential and applied knowledge of Environmental Science. It explains how the protection of our environment and ecological balance are linked with the development process. It makes them understand that key to development of the future of mankind is the sustenance of "Nature". Furthermore, the course emphasizes the duty and responsibility of each one to protect "Nature". This course enables the study of environment as an integral part of the education process so as to apply wherever relevant in their fields. The course motivates the students to conduct programs, research, and engage in outreach activities to meet Sustainable Development Goals (SDGs). Further it creates awareness on various Environmental issues among learners of the Campus for One Earth, One Family, One Future, drawing upon the age-old belief of *Vasudhaiva Kutumbakam.*

Course Objectives:

1. Adopt an interdisciplinary approach by integrating concepts from biology, chemistry, physics, geology, geography and social sciences to understand the complex environmental problems and natural resource degradation
2. Impart knowledge about various environmental systems, including ecosystems, biodiversity, atmosphere, hydrosphere, and lithosphere and their interaction.
3. Develop analytical and problem – solving skills required addressing environmental challenges such as pollution, climate change, resource management and their conservation and natural disasters management
4. Promote awareness of sustainable development principles and practices, including sustainable agriculture, renewable energy, waste management and environmental policy.
5. Foster an understanding of ethical considerations and social responsibilities related to environmental decision-making and management.

Course Outcomes:

At the end of the course, the students will be able to

CO	Course Outcomes	BTL
CO1	Examine various factors causing degradation of natural resources	K3
CO2	Explain various ecosystems and need for biodiversity	K3
CO3	Analyze problems related to environmental pollution and disaster management and propose solutions	K4
CO4	Explore the importance of ethics, sustainable development, and acts associated with environment	K4

CO5	Demonstrate use of information and technology to solve social issues and human rights challenges	K3

Course articulation matrix

	POs										
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	-	-	-	-	2	-	-	-	-	-
CO2	-	3	2	-	-	2	2	-	2	-	-
CO3	-	3	2	-	-	3	-	-	-	-	2
CO4	-	-	-	-	-	2	3	3	-	2	2
CO5	-	-	-	-	-	2	3	3	-	2	2

(1-Low, 2 -Medium, 3–High)(WK1)

Course Content

Unit 1

Introduction and Natural Resources

- Definition, scope, importance, multidisciplinary nature, and need for public awareness about environment.
- Forest resources
- Water resources
- Mineral resources
- Food resources
- Land resources
- Energy resources

Unit 2

Ecosystems and Biodiversity Structure and function of ecosystem

- Energy flow on the ecosystem
- Ecological succession
- Food chain food web ecological pyramids
- Characteristic features of ecosystems
- Biodiversity types, value, threats and conservation
- Biodiversity at local, national and global levels
- Hot-spots of biodiversity, endangered and endemic species of India.
- Bio-geographical Classification of India

Unit 3

Environmental Pollution and Disaster management

- Air Pollution
- Water pollution
- Noise pollution

- Soil pollution
- Marine pollution
- Thermal pollution
- Nuclear pollution
- Solid waste management: municipal solid waste, biomedical waste and E-waste.
- Disaster management: floods, cyclones, Earthquakes and landslides.

Unit 4

Social Issues and the Environment From unsustainable to sustainable development

- Urban problems related to energy
- Water conservation, rainwater harvesting and watershed management
- Environmental ethics
- Climate change
- Environmental protection acts
- Environment Impact Assessment: E.I.A.

Unit 5

Human Population and the Environment

- Population growth variation among nations.
- Population explosion family welfare program.
- Environment and human health.
- Human rights.
- Value education.
- HIV/AIDS
- Women and child welfare.
- Role of I.T.in Environment and human health.

Text Books:

1. Erach Bharucha, (2005). *Environmental Studies for undergraduate courses* (2nd ed.). University Grants Commission, New Delhi, Bharati Vidyapeeth Institute of Environment Education and Research.
2. Benny Joseph, (2005). *Environmental Studies*. Tata McGraw- Hill publishing company limited, New Delhi.
3. VenuGopalaRao,P.(2006).*PrinciplesofEnvironmentalScience&Engineering*.Prenti ce- Hall of India Pvt. Ltd., New Delhi.

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1. De, A.K.(2018) *Environmental Chemistry*(9thed.).New Age India.
2. Bharucha Erach,(2002)*Biodiversity of India*. Mapin Publishing.
3. Anjaneyulu,Y.(2004)*Introduction to Environmental sciences*. B S Publications, Hyderabad.
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5. CunninghamWillam,P.&CunninghamMaryAnn(2017)*EnvironmentalScience:A Global Concern* (14th ed.).Mc Graw Hill.
6. Kurian Joseph & Nagendran,R.(2005) *Essentials of Environmental Studies.*

Pearson Education.
Web Resources: • https://www.ugc.gov.in/oldpdf/modelcurriculum/env.pdf?iframe=true&width=100%25&height=100%25 • https://www.ugc.gov.in/oldpdf/modelcurriculum/chapter2.pdf • https://www.ugc.gov.in/oldpdf/modelcurriculum/chapter4.pdf • https://www.britannica.com/science/pollution-environment • https://www.supersummary.com/the-snow-leopard/summary/ • https://www.gov.nl.ca/ecc/waterres/waste/water-conservation/ • https://theberkey.com/pages/a-guide-to-water-conservation • https://www.mppcb.mp.gov.in/RWH.aspx • https://www.cseindia.org/understanding-eia-383 • https://www.drishtiias.com/to-the-points/paper3/environmental-impact-assessment-1 • https://www.drishtiias.com/to-the-points/paper3/wetlands-1 • https://odphp.health.gov/healthypeople/objectives-and-data/browse-objectives/environmental-health • https://www.who.int/health-topics/environmental-health#tab=tab_1 • https://www.unep.org/

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