SHIV NADAR
UNIVERSITY
CHENNAI

Rajiv Gandhi Salai, Kalavakkam – 603 110

# SSN School of Engineering

## DEPARTMENT OF CHEMICAL ENGINEERING

## B.TECH. CHEMICAL ENGINEERING

## CURRICULUM & SYLLABUS

## REGULATIONS 2025

## PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

**PEO 1: Career Achievement:** Our graduates will have a successful career in chemical and allied industries by demonstrating their skills in facing the challenges posed by the ever-changing chemical industrial and research sector.

**PEO 2: Professionalism:** Out graduates will exhibit their leadership qualities by taking suitable decisions and also work with multidisciplinary teams where they will discharge their social responsibilities as engineers by following ethical practices.

**PEO 3: Life-long Learning:** Our graduates will continue to expand their technical competence by developing their knowledge, skills and engaging themselves in learning activities throughout their life.

## PROGRAM OUTCOMES (POs)

**PO1: Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems. (WK1 to WK4)

**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)

## PROGRAM SPECIFIC OUTCOMES (PSOs)

**PSO 1:** Apply chemical engineering principles to design, simulate, analyze, control, and optimize chemical processes for efficient and sustainable operation.

**PSO 2:** Develop safe, sustainable, and innovative engineering solutions to current and emerging societal needs by leveraging modern chemical engineering tools and technologies.

# CURRICULUM

## SEMESTER - I

| Sl. No. | Course Title | Course Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|
| **1** | Matrices and Calculus | MD | 4 | 3 | 1 | 0 | 4 |
| **2** | Engineering Chemistry | MD | 4 | 2 | 0 | 2 | 3 |
| **3** | Communicative English | AEC | 4 | 2 | 0 | 2 | 3 |
| **4** | Engineering Graphics | SEC | 4 | 2 | 0 | 2 | 3 |
| **5** | Introduction to Chemical Engineering | MC | 3 | 3 | 0 | 0 | 3 |
| **6** | Professional Ethics and Human Values | VAC | 2 | 2 | 0 | 0 | 2 |
| **7** | Programming in Python for Data Science | VAC | 3 | 1 | 0 | 2 | 2 |
| **8** | Makers Space Laboratory | SEC | 4 | 0 | 0 | 4 | 2 |
| **9** | Extra Academic Activity 1* | VAC | 2 | 0 | 0 | 2 | 1* |
| **Total** | | | **30** | **15** | **1** | **14** | **22+1*** |

## SEMESTER - II

| Sl. No | Course Title | Course Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|
| **1** | Differential Equations and Complex Functions | MC | 3 | 3 | 0 | 0 | 3 |
| **2** | Technical Writing | AEC | 4 | 2 | 0 | 2 | 3 |
| **3** | Engineering Physics | MD | 5 | 3 | 0 | 2 | 4 |
| **4** | Environmental Science | VAC | 2 | 2 | 0 | 0 | 2 |
| **5** | Engineering Thermodynamics | MC | 3 | 3 | 0 | 0 | 3 |
| **6** | Principles of Electrical and Electronics Engineering | MC | 4 | 2 | 0 | 2 | 3 |
| **7** | Solid Mechanics for Technologists | MC | 3 | 3 | 0 | 0 | 3 |
| **8** | Chemical Analysis Laboratory | MC | 4 | 0 | 0 | 4 | 2 |
| **9** | Extra Academic Activity 2* | VAC | 2 | 0 | 0 | 2 | 1* |
| **Total** | | | **30** | **18** | **0** | **12** | **23+1*** |

***Note at a later page on Extra Academic Activity.**

## SEMESTER - III

| Sl. No. | Course Title | Course Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|
| **1** | Applied Mathematics for Chemical Engineers | MS | 3 | 3 | 0 | 0 | 3 |
| **2** | Instrumental Methods of Analysis | MC | 2 | 2 | 0 | 0 | 2 |
| **3** | Chemical Process Industries | MS | 2 | 2 | 0 | 0 | 2 |
| **4** | Fluid Mechanics for Chemical Engineers | MC | 3 | 3 | 0 | 0 | 3 |
| **5** | Design Thinking, Innovation and Entrepreneurship | SEC | 4 | 2 | 0 | 2 | 3 |
| **6** | Chemical Process Calculations | MC | 3 | 3 | 0 | 0 | 3 |
| **7** | Data Science Lab for Chemical Engineers | MC | 4 | 0 | 0 | 4 | 2 |
| **8** | Fluid Mechanics for Chemical Engineers Laboratory | MC | 4 | 0 | 0 | 4 | 2 |
| **9** | Fluid Flow Simulation Software | SEC | 2 | 0 | 0 | 2 | 1 |
| **Total** | | | **27** | **15** | **0** | **12** | **21** |

## SEMESTER - IV

| Sl. No. | Course Title | Course Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1 | Heat Transfer | MC | 3 | 3 | 0 | 0 | 3 |
| 2 | Materials Science and Technology | MC | 2 | 2 | 0 | 0 | 2 |
| 3 | Mass Transfer I | MC | 3 | 3 | 0 | 0 | 3 |
| 4 | Mechanical Operations | MC | 5 | 3 | 0 | 2 | 4 |
| 5 | Energy Audit and Management | MS | 2 | 2 | 0 | 0 | 2 |
| 6 | Chemical Engineering Thermodynamics | MC | 3 | 3 | 0 | 0 | 3 |
| 7 | Heat Transfer Laboratory | MC | 4 | 0 | 0 | 4 | 2 |
| 8 | Piping and Instrumentation Diagram | SEC | 2 | 0 | 0 | 2 | 1 |
| **Total** | | | **24** | **16** | **0** | **8** | **20** |

## SEMESTER - V

| Sl. No. | Course Title | Course Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|
| **1** | Process Engineering Economics | MC | 3 | 3 | 0 | 0 | 3 |
| **2** | Chemical Reaction Engineering I | MC | 3 | 3 | 0 | 0 | 3 |
| **3** | Mass Transfer II | MC | 2 | 2 | 0 | 0 | 2 |
| **4** | Numerical Methods in Chemical Engineering | MC | 5 | 3 | 0 | 2 | 4 |
| **5** | Sustainable Energy Technology | MS | 3 | 3 | 0 | 0 | 3 |
| **6** | Experimental and Analytical Methods in Chemical Engineering | MS | 3 | 3 | 0 | 0 | 3 |
| **7** | Mass Transfer Laboratory | MC | 4 | 0 | 0 | 4 | 2 |
| **Total** | | | **23** | **17** | **0** | **6** | **20** |

## SEMESTER - VI

| Sl. No. | Course Title | Course Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|
| **1** | Transport Phenomena | MC | 3 | 3 | 0 | 0 | 3 |
| **2** | Chemical Reaction Engineering II | MC | 2 | 2 | 0 | 0 | 2 |
| **3** | Process Instrumentation, Dynamics and Control | MC | 5 | 3 | 0 | 2 | 4 |
| **4** | Industrial Process Plant Safety | MC | 2 | 2 | 0 | 0 | 2 |
| **5** | Program Minor 1 | MS | 3 | 3 | 0 | 0 | 3 |
| **6** | Program Minor 2 | MS | 3 | 3 | 0 | 0 | 3 |
| **7** | Chemical Reaction Engineering & Thermodynamics Laboratory | MC | 4 | 0 | 0 | 4 | 2 |
| **8** | Capstone Project Phase 1 | PD | 8 | 0 | 0 | 8 | 4 |
| **Total** | | | **30** | **16** | **0** | **14** | **23** |

## SEMESTER - VII

| Sl. No. | Course Title | Course Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|
| **1** | Chemical Process Modeling and Simulation | MC | 6 | 2 | 0 | 4 | 4 |
| **2** | Process Equipment Design | MC | 4 | 2 | 0 | 2 | 3 |
| **3** | Program Minor 3 | MS | 3 | 3 | 0 | 0 | 3 |
| **4** | Program Minor 4 | MS | 3 | 3 | 0 | 0 | 3 |
| **5** | Program Minor 5 | MS | 2 | 2 | 0 | 0 | 2 |
| **6** | Ability Enhancement Course# | AEC | 3 | 1 | 0 | 2 | 2 |
| **7** | Capstone Project Phase 2 | PD | 12 | 0 | 0 | 12 | 6 |
| **8** | Internship | SI | 4 | 0 | 0 | 4 | 2 |
| **Total** | | | **37** | **13** | **0** | **24** | **25** |

#The following is a list of courses that are offered under the Ability Enhancement Course:
1. Writing for Research
2. Creative Writing
3. Psychology and Communication
4. Professional Communication

## SEMESTER - VIII

| Sl. No. | Course Title | Course Category | Contact Periods | L | T | P | C |
|---|---|---|---|---|---|---|---|
| **1** | Program Minor - 6 | MS | 2 | 2 | 0 | 0 | 2 |
| **2** | Program Minor -7 | MS | 3 | 3 | 0 | 0 | 3 |
| **3** | Capstone Project Phase 3 | PD | 4 | 0 | 0 | 4 | 2 |
| **Total** | | | **9** | **5** | **0** | **4** | **7** |

## COURSE SUMMARY

The listed courses are broadly classified as per the recommendations from the UGC.

| Sl. No. | Broad Category of Course | Minimum Credit Requirement | Credit Distribution (SNU) |
|---|---|---|---|
| 1 | Major Core (MC) | 80 | 80 |
| 2 | Minor Stream (MS) | 32 | 32 |
| 3 | Multidisciplinary (MD) | 09 | 11 |
| 4 | Ability Enhancement Course (AEC) | 08 | 08 |
| 5 | Skill Enhancement Course (SEC) | 09 | 10 |
| 6 | Value Added Courses (VAC) | 06-08 | 06 + 2* |
| 7 | Summer Internship (SI) | 02-04 | 02 |
| 8 | Project Dissertation (PD) | 12 | 12 |
| **Total** | | **160** | **161+2*** |

The semester wise credit breakup of the Curriculum based on the above credit breakup proposed by the UGC is as follows:

| Semester / Category | MC | MS | MD | AEC | SEC | VAC | SI | PD | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | - | 7 | 3 | 5 | 4+1* | - | - | 22+2* |
| 2 | 14 | - | 4 | 3 | | 2+1* | - | - | 23+1* |
| 3 | 12 | 5 | - | - | 4 | - | - | | 21 |
| 4 | 17 | 2 | - | - | 1 | - | - | - | 20 |
| 5 | 14 | 6 | - | - | - | - | - | - | 20 |
| 6 | 13 | 6 | - | - | - | - | - | 4 | 23 |
| 7 | 7 | 8 | - | 2 | - | - | 2 | 6 | 25 |
| 8 | - | 5 | - | - | - | - | - | 2 | 7 |
| **Total** | 80 | 32 | 11 | 8 | 10 | 6+2* | 2 | 12 | **161+2*** |

* The credits earned through the Extra Academic Activities in Value Added Courses (VAC) are not included in the calculation of Cumulative Grade Point Average (CGPA).

## MINOR STREAMS

The Department of Chemical Engineering offers the following list of Minor Streams.

1. Digitalization, AI, and Machine Learning
2. Industrial Safety and Management (Foundation minor)
3. Advanced Materials and Nanotechnology

Each Minor Stream has seven courses worth 19 credits. The student must enroll in any one of the above three Minor Streams. Minor Streams tagged with Foundations must not be enrolled by students whose Major Core courses overlap with the listed courses in the Minor Stream.

## MINOR STREAM 1 - Digitalization, AI, and Machine Learning

| Sl. No. | Course Title | Semester | Contact Hours | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1 | Fundamentals of AI and ML* | 6 | 3 | 3 | 0 | 0 | 3 |
| 2 | Process Control and Optimization* | 6 | 3 | 3 | 0 | 0 | 3 |
| 3 | Data Analytics for Chemical Engineers* | 7 | 3 | 3 | 0 | 0 | 3 |
| 4 | Introduction to Molecular Modeling* | 7 | 3 | 3 | 0 | 0 | 3 |
| 5 | MINOR STREAM BASKET 1 | 7 | 2 | 2 | 0 | 0 | 2 |
| 6 | MINOR STREAM BASKET 2 | 8 | 2 | 2 | 0 | 0 | 2 |
| 7 | MINOR STREAM BASKET 3 | 8 | 3 | 3 | 0 | 0 | 3 |

*Mandatory Course for the Minor Stream

The following is the tentative list of courses that may be offered under the ***Minor Stream Baskets***:

| ***Minor Stream Basket 1 (2 Credit courses)*** | ***Minor Stream Basket 2 (2 Credit courses)*** | ***Minor Stream Basket 3 (3 Credit courses)*** |
|---|---|---|
| Process Simulation Software | Application of Machine Learning for Process Optimization | Molecular Dynamics Simulation for Chemical Engineers |
| Application of CFD | Neural Networks for Process Modeling | Introduction to Digital Twin Technology |
| Process Modeling and Simulation with MATLAB | Reinforcement Learning for Process Control | Industrial Internet of Things (IIoT) for Chemical Plants |
| Chemical Process Flow Sheeting | Predictive Analysis for Chemical Processes | Quantum Chemistry for Process Engineers |

## MINOR STREAM 2 - Industrial Safety and Management

| Sl. No. | Course Title | Semester | Contact Hours | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1 | Fundamentals of Industrial, Environmental and Occupational Safety* | 6 | 3 | 3 | 0 | 0 | 3 |
| 2 | Environmental Impact Assessment* | 6 | 3 | 3 | 0 | 0 | 3 |
| 3 | Industrial Safety, Health and Environment Acts* | 7 | 3 | 3 | 0 | 0 | 3 |
| 4 | Hazard Analysis and Risk Assessment | 7 | 3 | 3 | 0 | 0 | 3 |
| 5 | MINOR STREAM BASKET 1 | 7 | 2 | 2 | 0 | 0 | 2 |
| 6 | MINOR STREAM BASKET 2 | 8 | 2 | 2 | 0 | 0 | 2 |
| 7 | MINOR STREAM BASKET 3 | 8 | 3 | 3 | 0 | 0 | 3 |

*Mandatory courses for the Minor Stream

The following is the tentative list of courses that may be offered under the ***Minor Stream Baskets***:

| ***Minor Stream Basket 1 (2 Credit)*** | ***Minor Stream Basket 2 (2 Credit courses)*** | ***Minor Stream Basket 3 (3 Credit courses)*** |
|---|---|---|
| Principles of Safety Management | Safety in Textile Industry | Fire Engineering and Protection |
| Disaster Management | Safety in Dust Handling | Occupational Health and Hygiene |
| Reliability Engineering | Safety in Oil and Gas industry | Loss prevention techniques and procedures |
| Risk Management | Transport Safety | Nuclear Safety and Radioactive Materials |

**Note: Students from B.Tech. Chemical Engineering must not opt for this Minor Stream.**

## MINOR STREAM 3 – Advanced Materials and Nanotechnology

| Sl. No. | Course Title | Semester | Contact Hours | L | T | P | C |
|---|---|---|---|---|---|---|---|
| 1 | Elements of Nanoscience and Nanotechnology* | 6 | 3 | 3 | 0 | 0 | 3 |
| 2 | Industrial Nanotechnology* | 6 | 3 | 3 | 0 | 0 | 3 |
| 3 | Nano Materials for Energy and Environment* | 7 | 3 | 3 | 0 | 0 | 3 |
| 4 | Materials Characterization and Analytical Techniques* | 7 | 3 | 3 | 0 | 0 | 3 |
| 5 | MINOR STREAM BASKET 1 | 7 | 2 | 2 | 0 | 0 | 2 |
| 6 | MINOR STREAM BASKET 2 | 8 | 2 | 2 | 0 | 0 | 2 |
| 7 | MINOR STREAM BASKET 3 | 8 | 3 | 3 | 0 | 0 | 3 |

*Mandatory courses for the Minor Stream

The following is the tentative list of courses that may be offered under the ***Minor Stream Baskets***:

| ***Minor Stream Basket 1 (2 Credit courses)*** | ***Minor Stream Basket 2 (2 Credit courses)*** | ***Minor Stream Basket 3 (3 Credit courses)*** |
|---|---|---|
| Basics of Nanotechnology in Tissue Engineering | Polymers: Concepts, Properties, Uses and Sustainability | Ferrous and non-Ferrous Metallurgy |
| Nanoscience and Technology of Ceramics | Polymer Process Engineering | Corrosion Science and Technology |
| Nanotechnology for Electrochemical Energy Storage | Composite Materials | Colloids and Surfaces |
| Semiconductor Materials and Nanodevices | Smart Materials | Behaviour and Selection of Materials |

# MICROSPECIALIZATION

The University proposes to offer Micro-Specializations to Undergraduate students. Its salient features are as follows:

1. Each Micro-Specialization has a defined structure in terms of three sequential components:
    - **Component I** - One Foundation course that constitutes a mandatory requirement and also a prerequisite for subsequent components.
    - **Component II** - Two courses from a specified vertical.
    - **Component III** - Project/Design/Term Paper
2. A Student would be required to complete all three components (10-14 credits) from the specified stream to earn a Micro-Specialization.

## Eligibility for Micro-Specialization registration

To register for a Micro-Specialization, the student must have completed all curricular requirements up to the previous semester and have a CGPA $\geq$ 8.5. The student must maintain a CGPA $\geq$ 8.5 without any backlog in the subsequent semesters to keep the Micro-Specialization registration active. Micro-Specialization must not overlap with the Major Core courses or Minor Stream courses credited as part of the degree program.

## Provisional List of Micro-Specialization Verticals

The following are the list of Micro-Specialization verticals that will be offered by our department:

1. Food Technology
2. Nanomedicine
3. Green Chemistry and Engineering
4. Quantum Chemical Engineering
5. Net Zero and Decarbonization
6. Polymer Engineering.

# SYLLABUS

# SEMESTER - I

| Course Code | Category | MATRICES AND CALCULUS (COMMON TO CIVIL, MECHANICAL, BIOMEDICAL, CHEMICAL) | L | T | P | C | Contact Hours |
|---|---|---|---|---|---|---|---|
| | MD | | 3 | 1 | 0 | 4 | 4 |
| Course Level | | *Prerequisite Courses: Nil* | | | | | |

**COURSE OBJECTIVES:**

- To apply the concepts of eigenvalues and eigenvectors in the reduction of quadratic form.
- To obtain the Taylor's expansion of various functions and extreme values of functions.
- To equip with the concepts of integral calculus and applying it in evaluating the integrals.
- To apply the Green's theorem, Divergence theorem and Stokes theorem in engineering problems

**UNIT I MATRICES (12 HOURS)**

Eigenvalues and Eigenvectors - Cayley-Hamilton Theorem - Diagonalization: Similarity transformation - Quadratic form – Reduction of quadratic form to canonical form using orthogonal transformation, Eigen values by Power method.

**UNIT II DIFFERENTIAL CALCULUS (12 HOURS)**

Curvature, radius of curvature - Cartesian and parametric forms – Centre of curvature – Circle of curvature in Cartesian form, Evolutes, Envelopes, Evolute as envelope of normals.

**UNIT III MULTIPLE INTEGRALS (12 HOURS)**

Double integrals, Triple integrals: Cartesian and polar coordinates – Change of order of integration, Change of variables, Area and volume as multiple integrals.

**UNIT IV VECTOR CALCULUS (12 HOURS)**

Gradient and directional derivative – Divergence and curl – Vector identities - line integral, Surface integral, Volume integral- Green's theorem, Gauss divergence and Stoke's theorems.

**UNIT V FUNCTIONS OF SEVERAL VARIABLE (12 HOURS)**

Partial derivatives – Total derivative – Jacobian – Functions of two variables: Taylor's series and Maxima and minima– Constrained optimization using Lagrange's method.

**TEXTBOOKS**

1. Grewal B.S, Higher Engineering Mathematics, Khanna Publishers, 45th Edition, 2020.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, Inc., 10th Edition, 2020.

**REFERENCE BOOKS**


1. Bali, N.P., Goyal, M., Watkins, C., Advanced Engineering Mathematics, Laxmi Publications Pvt. Limited, 2007.
2. Boyce, W.E., and DiPrima, R.C., Elementary Differential Equations and Boundary Value Problems, Wiley India, 2012.
3. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass, Thomas' Calculus: Early Transcendental, 13th Edition, Pearson Education, 2013.
4. O'Neil. P. V., Advanced Engineering Mathematics, 7th Edition, Cengage Learning India Pvt., Ltd, New Delhi, 2011.
5. Howard Anton, Irl C. Bivens, Stephen Davis, Calculus Early Transcendentals, 11th Edition, John Wiley & Sons, Inc., 2016.


**COURSE OUTCOMES:**

| | **Course Outcomes** | **Knowledge Level** |
|---|---|---|
| **CO1** | Analyze and diagonalize matrices using eigenvalues, eigenvectors, and similarity transformations. | KL3 |
| **CO2** | Compute curvature, radius, and centre of curvature, and find evolutes and envelopes of plane curves. | KL3 |
| **CO3** | Evaluate double and triple integrals in Cartesian and polar coordinates, change the order of integration, and compute areas and volumes using multiple integrals. | KL3 |
| **CO4** | Evaluate vector integrals using gradient, divergence, curl, and theorems like Green's, Gauss, and Stokes | KL3 |
| **CO5** | Evaluate partial derivatives, total derivatives, Jacobians, and use Taylor series and Lagrange's method to solve maxima, minima, and constrained optimization problems. | KL3 |

| Course Code | Category | ENGINEERING CHEMISTRY | L | T | P | C | Contact Hours |
|---|---|---|---|---|---|---|---|
| | MD | | 2 | 0 | 2 | 3 | 4 |
| Course Level | | *Prerequisite Courses: Nil* | | | | | |

**COURSE OBJECTIVES:**

This course aims to:

1. To acquire knowledge on water chemistry and treatment methods relevant to industrial and engineering applications.
2. To apply electrochemical principles in energy storage systems, fuel cells, batteries, and supercapacitors.
3. To understand and analyze corrosion mechanisms and protection techniques for engineering materials under various environments.
4. To understand the properties, processing, and applications of polymers and composite materials.
5. To acquire knowledge on various material characterization techniques and apply the skills in laboratory analysis using modern analytical techniques.

**UNIT I WATER AND ITS TREATMENT (12 HOURS)**

Theory: Hardness of water – types – expression of hardness – units – estimation of hardness of water by EDTA- numericals; Boiler feed water chemistry- scale formation, sludge, carryover, priming & foaming; Boiler corrosion: oxygen corrosion, acidic corrosion, Caustic embrittlement in boiler materials; Cooling water chemistry for heat exchangers, condensers, and IC engines. Anti-corrosion, anti-scaling, and antifreeze additives.

Practical

Exp.1: Estimation of hardness of water

Exp.2: Estimation of alkalinity of water

Laboratory Demonstration:

- Ion Exchange process

**UNIT II ELECTROCHEMISTRY (12 HOURS)**

Theory: Electrochemistry- redox reaction- Ion selective electrodes –Glass electrodes-measurement of pH-potentiometry; Energy systems for electric vehicles – Principles & electrochemistry of: $H_2$–$O_2$ fuel cell, Li-ion battery & Na-ion battery, Battery degradation mechanisms and thermal runaway relevance to EV and hybrid vehicles, Green Hydrogen, Supercapacitors: working principles and applications in regenerative braking.

Practical

Exp.3: Estimation of strong acid-pH metry

Exp.4: Estimation of ferrous ion by potentiometry

**UNIT III CORROSION (12 HOURS)**

Theory: Corrosion- Types of corrosion – Dry corrosion, wet corrosion; Types of wet Corrosion-galvanic corrosion, differential aeration -simplified Pourbaix diagram interpretation- Rate of corrosion; Corrosion in Machine Parts: Stress Corrosion Cracking (SCC), Hydrogen Embrittlement, High-temperature corrosion, Fretting corrosion and erosion; Protective coatings for mechanical assemblies-anodizing, ceramic coatings, diffusion coatings

Microbiologically induced corrosion and concrete deterioration: biodeterioration of stone monuments. Microbial induced calcite precipitation: preparation and mechanism and utilization in biocementation, concrete repair and environmental remediation.

Practical

Exp.5: Estimation of dissolved oxygen

Exp. 6: Estimation of rate of corrosion

**UNIT IV ENGINEERING PLASTICS (12 HOURS)**

Theory: Polymers – Properties: Crystallinity, Glass Transition temperature (Tg), Viscosity Average Molecular weight-viscosity method &PDI, tacticity; Fiber reinforced polymeric materials: Key properties of FRP materials and its application in construction industries; Polymer concrete: Polymer Impregnated concrete, polymer cement concrete, Fiber reinforced concrete; Elastomers & rubber chemistry: vulcanization and mechanical behavior; Polymer degradation mechanisms: thermal, oxidative, UV degradation relevance to mechanical design and durability.

Practical:

Exp.7: Determination of Molecular weight of water-soluble polymer by viscosity method

Exp.8: Finding the Tg point of different polymer-Demo

**UNIT V MATERIAL CHARACTERISATION (12 HOURS)**

Theory: Scanning Electron Microscopy (SEM): fracture analysis, wear analysis, microstructure; X-Ray Diffraction (XRD): phase identification in metals and alloys; Thermal analysis techniques: DSC Differential Scanning Calorimetry (DSC): Thermogravimetric Analysis (TGA); Material Hardness testing methods: Vickers, Rockwell, Brinell

Practical:

Exp.9: Estimation of Cu in Brass

Ex 10: Interpretation of TGA curves-Demo

**TEXT BOOKS:**

1. Jain P.C. and Monika Jain, 'Engineering Chemistry' 17th edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2023.
2. S.S.Dara, 'The Text Book of Engineering Chemistry, S.Chand & Co.Ltd,New Delhi, 2011.

**REFERENCE BOOKS**


1. N. F. Gray, Water Technology – An Introduction for Environmental Scientists and Engineers, 3rd ed., USA: Taylor & Francis, 2010.
2. S. Glasstone, An Introduction to Electrochemistry, New Delhi: East-West Press Pvt. Ltd., 2007.
3. B. Sundén, Hydrogen, Batteries and Fuel Cells, USA: Academic Press Inc., 2019.
4. R. Gowariker, N. V. Viswanathan, and J. Sreedhar, Polymer Science, New Delhi: New Age International (P) Ltd., Reprint, 2005.
5. B.Viswanath, B, P.S. Raghavan, 'Practical Physical Chemistry'.ViVa Books PVT. Ltd, New Delhi, 2012


**COURSE OUTCOMES:**

| | Course Outcomes | Knowledge Level |
|---|---|---|
| **CO1** | Apply standard analytical techniques to identify impurities in water samples and select appropriate treatment methods for domestic and industrial applications. | KL3 |
| **CO2** | Analyze electrochemical systems to identify existing challenges and evaluate strategies for improving fuel cell and battery technologies for zero-emission mobility. | KL3 |
| **CO3** | Identify the type of corrosion and analyze different preventive methods of corrosion in various industries. | KL3 |
| **CO4** | Evaluate the mechanical and thermal performance of engineering polymers, elastomers, and rubbers to determine their durability and suitability for material design applications. | KL3 |
| **CO5** | Apply SEM, XRD, thermal analysis, and hardness testing techniques to characterize materials and relate results to material chemistry. | KL3 |

| Course Code | Category | COMMUNICATIVE ENGLISH | L | T | P | C | Contact Hours |
|---|---|---|---|---|---|---|---|
| | AEC | | 2 | 0 | 2 | 3 | 4 |
| Course Level | | *Prerequisite Courses: Nil* | | | | | |

**COURSE OBJECTIVES:**

The learners will be able to:

1. Enhance conversation fluency and networking skills in English.
2. Contribute efficiently to meetings and group discussions.
3. Deliver well-structured presentations and participate in interviews.
4. Learn the language and strategies of successful negotiations.
5. Communicate effectively during conflict-resolving situations.

**UNIT I CONVERSATION AND NETWORKING SKILLS (12 HOURS)**

Introducing yourself, peers and others. Conversation skills: starting a conversation; keeping the conversation going; closing the conversation; giving directions and instructions; learning functional language needed for everyday interactions. Imparting the basic language skills and techniques for telephonic conversations. Role-plays as a technique for practicing conversation. Writing professional emails.

**UNIT II MEETING AND GROUP DISCUSSION SKILLS (12 HOURS)**

Setting up and holding meetings; organizing and conducting effective meetings; learning the language used to lead a meeting; practicing how to agree and disagree with ideas and people politely. Research and pre-meeting preparation and mock meetings. Making notes, summarizing, and reporting in meetings. Group discussion skills: Basic skills required for a GD; strategies for improving discussion skills; learning the language used for a GD; voicing an opinion and arguing a point effectively, leading a discussion; chairing a discussion; discussing to arrive at a consensus. Research and pre-GD preparation, and mock GDs for practice.

**UNIT III PRESENTATION AND INTERVIEW SKILLS (12 HOURS)**

Making effective presentations: structure of a presentation; referring to visual data; describing visuals; non-verbal communication skills; examples of model presentations; and learning the language used to deliver effective and persuasive presentations. Advance topic research and mock presentations for practice. Applying for jobs; writing resumes; and cover letters. Participating in job interviews and other interviews. Strategies for effective interviewing: preparing for the interview, during-the-interview and after-the-interview etiquette. Common interview questions and learning interviewing language skills. Mock interviews for practice.

**UNIT IV NEGOTIATION SKILLS AND ASSERTIVENESS (12 HOURS)**

Negotiation strategies; negotiating effectively; exchanging and comparing information; building rapport with people; practicing the language used in negotiations; considering and respecting cultural differences while negotiating; making compromises. Communication styles: passive, aggressive and assertive. Reading case studies and mock negotiation role plays.

**UNIT V CONFLICT RESOLUTION AND DECISION-MAKING SKILLS (12 HOURS)**

Resolving conflicts: listening actively to ideas; handling people smoothly; dealing with and attempting to solve conflicting problems. Making a decision: thinking about various possibilities before decision-making; communicating the pros and cons of a decision; presenting a mutually beneficial solution. Reading case studies and mock conflict resolution role plays. Developing cross-cultural communication skills.

**TEXTBOOKS:**


1. Bovee, C. L.& Thill, J. V. (2016). *Business Communication Today, 15/e*. Pearson Education India.
2. Beebe, S. A., & Mottet, T. P. (2021). *Business and Professional Communication (3rd ed)*. Pearson Higher Education AU.
3. Herbert Hirsch. (2007). Essential Communication Strategies: For Scientists, Engineers, and Technology Professionals, 2nd edition. Wiley-IEEE Press.


**REFERENCES:**


1. Dodd, C. H. (2012). Managing business and professional communication (3rd ed). Allyn & Bacon/Pearson.
2. Dwyer, J. (2012). *Communication for Business and the Professions: Strategies and Skills* (7th ed). Pearson Higher Education AU.
3. Gill Hasson. (2012). Brilliant Communication Skills: What the Best Communicators Know, Do and Say. Ft Pr.
4. Jones, L., & Alexander, R. (2011). *New international business English updated edition student's book: Communication skills in English for business purposes* (Vol. 3). Cambridge university press.
5. Kerry Patterson, Joseph Grenny, Ron McMillan and Al Switzler. (2013). Crucial Conversations: Tools for Talking When Stakes Are High. Brilliance Audio.

**COURSE OUTCOMES:**

| | Course Outcomes | Knowledge Level |
|---|---|---|
| **CO1** | Develop conversation skills and networking skills in English. | KL3 |
| **CO2** | Communicate effectively in meetings and group discussions. | KL4 |
| **CO3** | Deliver engaging presentations and professional interviews. | KL5 |
| **CO4** | Speak and negotiate strategically in formal and informal settings. | KL4 |
| **CO5** | Present effectively during conflict resolving situations. | KL5 |

| Course Code | Category | ENGINEERING GRAPHICS (Common to MECH/CHEM/CIVIL) | L | T | P | C | Contact Hours |
|---|---|---|---|---|---|---|---|
| | SEC | | 2 | 0 | 2 | 3 | 4 |
| Course Level | | *Prerequisite Courses: Nil* | | | | | |

**COURSE OBJECTIVES:**

- To introduce the use of drawing instruments and CAD tools for professional practice.
- To enable clear and precise communication of engineering ideas through standard drawings
- To establish a fundamental basis for design and drafting for engineering applications.

**Unit I FREEHAND SKETCHING AND PROJECTION OF POINTS and LINES (9 HOURS)**

Visualization concepts and Free Hand sketching: Visualization principles–Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects. – **By Conventional Method.**

Projections of points when they are situated in different quadrants. Projections of a line parallel to one of the reference planes and inclined to the other, line inclined to both the reference planes. Determination of true lengths and true inclinations by rotating line method. – **By Conventional Method.**

**UNIT II FUNDAMENTALS OF AUTOCAD - PROJECTION OF PLANES AND SOLIDS (9 HOURS)**

Introduction to AutoCAD, DRAW tools, MODIFY tools, TEXT, DIMENSION.
Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating plane method. **Conventional and AutoCAD**

Projections of solids like prisms, pyramids, cylinder and cone, whose axis is parallel to one of the reference planes and inclined to the other by rotating object method. **Conventional and AutoCAD**

**UNIT III SECTION OF SOLIDS (9 HOURS)**

Sectional planes – when the cutting plane is inclined to one of the principal planes and perpendicular to the other, Sectional views - Prism, pyramid, cylinder and cone, true shape of the section. **Conventional and AutoCAD**

**UNIT IV DEVELOPMENT OF SURFACES (9 HOURS)**

Development of lateral surfaces of simple and truncated solids in vertical position– prisms, cylinders, pyramids, cones. **Conventional and AutoCAD**

**UNIT V ISOMETRIC PROJECTION (9 HOURS)**

Principles of isometric projection – isometric scale – Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions **Conventional and AutoCAD**

**Textbooks:**


1. Venugopal, K. and Prabhu Raja, V., Engineering Drawing + AutoCAD, New Age International (P) Limited, 2022, ISBN - 13: 9788122472752.
2. Natarajan, K.V., A Textbook of Engineering Graphics, Dhanalakshmi Publishers, Chennai, 33rd Edition, 2020. [ISBN: 9788190414089].
3. Ramesh babu. V, A Textbook on Engineering Graphics, VRB Publishers, Chennai, 2022. [ISBN - 13: 978-93-95018-55-5.]


**References:**


1. Bhatt, N.D., Engineering Drawing, Charotar Publishing House, 2025. [ISBN: 9789385039805].
2. Prof. Sham Tickoo, *AutoCAD 2017 for Engineers & Designers*, 23ed, Dreamtech Press[ISBN: 9789351199465]
3. Basant Agarwal, and Agarwal, C.M., Engineering Drawing, McGraw Hill, 3rd Edition, 2019. [ISBN: 9789353167448]
4. Parthasarathy, N. S. and Vela Murali, "Engineering Drawing", Oxford University Press,2015.[ISBN: 9780199455393]

**COURSE OUTCOMES:**

| | Course Outcomes | Knowledge Level |
|---|---|---|
| **CO1** | Construct the orthographic views of an object and projection of points and lines. | KL3 |
| **CO2** | Construct the Projection of Planes and Solids in conventional and CAD environment. | KL3 |
| **CO3** | Construct the details of an object through sectional views, in conventional and CAD environment. | KL3 |
| **CO4** | Develop the lateral surface of the solids in conventional and CAD environment. | KL4 |
| **CO5** | Construct the three-dimensional isometric view in conventional and CAD environment. | KL4 |
| **CO6** | Analyze the internal details of the industrial component through sectional and isometric views. | KL4 |

| Course Code | Category | INTRODUCTION TO CHEMICAL ENGINEERING | L | T | P | C | Contact Hours |
|---|---|---|---|---|---|---|---|
| | MC | | 3 | 0 | 0 | 3 | 3 |
| Course Level | | *Prerequisite Courses: Nil* | | | | | |

**COURSE OBJECTIVES:**

- To provide a comprehensive overview of major chemical engineering operations, including unit processes, equipment, and their industrial applications.
- To inspire students to pursue in-depth exploration of chemical engineering principles and career opportunities through real-world examples and emerging technologies.

**UNIT I INTRODUCTION TO CHEMICAL ENGINEERING (9 HOURS)**

Introduction to Chemical Engineering - Chemical process industries - History and their role in Society - Job roles and job opportunities available to chemical engineers. Unit operations and unit processes concepts. Flow sheet representation of process plants with example such as Sulfuric acid and Soda Ash manufacture. Recent developments in chemical process industries.

**UNIT II INTRODUCTION TO MATERIAL BALANCES AND FLUID FLOW (9 HOURS)**

Commonly used physical properties of solutions. Material and Energy balance and their importance simple calculations. Stoichiometric requirement of chemicals for reactions. Role of process streams such as recycle, bypass and purge in a typical reactor-separator system. Concept of Fluid Flow – Operation and equipment used for transportation of fluids. Fluid flow - laminar and turbulent flow – Basics of frictional losses – flow meters – Pumps. Introduction to Mixing and Agitation.

**UNIT III INTRODUCTION TO PROCESS HEAT TRANSFER (9 HOURS)**

Role of heat transfer in process industries. Modes of heat transfer operation – Introduction to conduction, convection and radiation heat transfer. Heat Exchangers – double pipe, shell-and-tube, and compact. Co-current and counter-current flow arrangement in heat exchangers - Variation of fluid temperature in heat exchangers. Evaporators – principles and uses – simple calculations.

**UNIT IV INTRODUCTION OF MASS TRANSFER OPERATIONS (9 HOURS)**

Role of Mass Transfer in process industries, Fundamentals – diffusivity – mass transfer coefficient. Absorption, Adsorption – distillation - Vapour-Liquid Equilibrium – Relative volatility- Need for multiple stages of contacting. Equipment for Gas - Liquid contacting. Liquid - Liquid Extraction - Selection of solvent. Humidification.

## UNIT V INTRODUCTION TO CHEMICAL REACTION ENGINEERING (9 HOURS)

Chemical Kinetics - Elementary and non-elementary reactions - Effect of temperature and concentration on reaction rate – Catalysis. Heat of reaction - Feasibility of a chemical reaction from thermodynamics. Overview of reactors - Batch and flow reactors – packed and fluidized bed reactors – Comparison.

**TEXTBOOKS:**


1. Badger W.L. and Banchero J.T., Introduction to Chemical Engineering, 6th Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2011.
2. Kenneth A. Solen, John N. Harb, Introduction to Chemical Engineering, 5thEdition, Wiley India Pvt Ltd., 2011.


**REFERENCES:**


1. Gopala Rao, M., Marshall Sittig, Dryden's Outlines of Chemical Technology – For the 21st Century, 3rd Edition, Affiliated East-West Press, New Delhi, 2009.
2. McCabe and Smith, Unit Operations of Chemical Engineering, 7th Edition, McGraw Hill, 2017.
3. Pushpavanam, S., Introduction to Chemical Engineering, PHI Learning Private Limited, New Delhi, 2012.


**COURSE OUTCOMES:**

| | Course Outcomes | Knowledge Level |
|---|---|---|
| **CO1** | Explain the critical role of chemical engineers in designing and optimizing large-scale industrial operations for efficient and sustainable chemical production. | KL3 |
| **CO2** | Comprehend core principles of chemical process stoichiometry, material/energy balances, and fluid dynamics to solve complex engineering problems. | KL4 |
| **CO3** | Articulate fundamental heat transfer mechanisms and classify different types of equipment. | KL4 |
| **CO4** | Elucidate mass transfer principles and classify different types of equipment. | KL4 |
| **CO5** | Analyze core chemical reaction engineering concepts and understand the different types of reactors. | KL4 |
| **CO6** | Analyze large-scale chemical production processes by integrating chemical engineering principles to optimize industrial operations, equipment selection, and their performance for sustainable chemical manufacturing. | KL4 |

| Course Code | Category | PROFESSIONAL ETHICS AND HUMAN VALUES | L | T | P | C | Contact Hours |
|---|---|---|---|---|---|---|---|
| | VAC | | 2 | 0 | 0 | 2 | 2 |
| Course Level | | *Prerequisite Courses: Nil* | | | | | |

**COURSE OBJECTIVES:**

1. To provide students with a foundation in ethics and human values for personal, social, and professional life.
2. To enable students to understand and apply ethical principles in decision-making and workplace conduct.
3. To develop awareness of social responsibility, civic virtues, and sustainable practices in professional and personal contexts.

**UNIT I INTRODUCTION TO ETHICS AND VALUES (6 HOURS)**

Meaning and scope of ethics, morals, and values, Life skills and emotional intelligence, Personal versus professional ethics, Stakeholders and their influence on decisions, Ethical dilemmas and methods of resolution, Case studies highlighting basic ethical issues

**UNIT II RESPONSIBILITY, SOCIAL IMPACT, AND WORKPLACE CONDUCT (6 HOURS)**

Attributes of a profession, roles, duties, and responsibilities, Professional obligations and social impact of decisions, Corporate Social Responsibility (CSR) and sustainable practices, Legal and social responsibilities, Workplace safety and rights, Case studies on societal and organizational ethical issues

**UNIT III THEORIES AND DECISION-MAKING FRAMEWORKS (6 HOURS)**

Major ethical theories: Utilitarianism, Deontology, Virtue Ethics, Rights-based approaches, Application of theories in professional scenarios, Decision-making frameworks for dilemmas, Responsibility for safety, health, and well-being, Risk assessment and accountability, Case studies illustrating applied concepts.

**UNIT IV RIGHTS, GLOBAL ISSUES, AND ETHICAL CODES (6 HOURS)**

Rights and duties in workplace, Professional standards and codes of conduct, Ethics audit: implementation and evaluation, Global challenges: environmental ethics, media ethics, bioethics, research ethics, Cross-cultural considerations and international case studies

**UNIT V HUMAN VALUES AND PROFESSIONAL DEVELOPMENT (6 HOURS)**

Nature, classification, and significance of human values, Value-based decision-making in personal and professional life, Integration of human values in daily life, Harmony with self, family, society, and environment, Developing positive attitudes, moral courage, and integrity, Strategies for internalizing and applying values, Coexistence -Practical exercises and case studies on character building and ethical living.

**TEXTBOOKS:**

1. Professional Ethics Includes Human Values, R. Subramanian, Oxford University Press, 2nd Edition, 2017.
2. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 3rd revised edition, 2023.

**REFERENCES:**

1. A Textbook on Professional Ethics and Human Values by R.S. Naagarazan, New Age Intl. Publishers, 2006.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. Human Values and Professional Ethics, by Vaishali R Khosla & Kavita Bhagat, Technical Publications, First Edition, 2009.

**COURSE OUTCOMES:**

| | Course Outcomes | Knowledge Level |
|---|---|---|
| **CO1** | Explain the basic concepts of ethics, morals, and values, and differentiate between personal and professional ethics. | KL2 |
| **CO2** | Describe the responsibilities of professionals and the social and legal impact of their decisions, including CSR and workplace safety. | KL2 |
| **CO3** | Discuss major ethical theories and their role in resolving ethical dilemmas in professional situations. | KL2 |
| **CO4** | Identify rights, professional standards, ethical codes, and global challenges relevant to workplace and international practices. | KL2 |
| **CO5** | Illustrate human values in personal and professional life to foster integrity, positive attitudes, and responsible behavior. | KL3 |

| Course Code | Category | PROGRAMMING IN PYTHON FOR DATA SCIENCE | L | T | P | C | Contact Hours |
|---|---|---|---|---|---|---|---|
| | VAC | | 1 | 0 | 2 | 2 | 3 |
| Course Level | | *Prerequisite Courses: Nil* | | | | | |

**COURSE OBJECTIVES:**

- To learn Python fundamentals and modularity in problem solving.
- To learn data types in Python and file handling.
- To learn numerical computations using NumPy.
- To learn data manipulations using Pandas.
- To perform visualization and statistical analysis using Python libraries.

**Unit I PYTHON FUNDAMENTALS (4 HOURS)**

Introduction to Python – Expressions and operators - Variables and Assignment - conditional and Iterative statement; Functions: Local and global scope, Methods of passing arguments, Recursion.

**Unit II DATA TYPES AND FILE HANDLING (3 HOURS)**

Compound Data Types: Strings - Lists - Tuples - Dictionaries; File handling.

**Unit III NUMPY FOR NUMERICAL COMPUTATION (2 HOURS)**

Arrays in Python – Array creation in NumPy – Indexing and slicing operations – Arithmetic operations – Statistical operations using NumPy.

**Unit IV PANDAS FOR DATA MANIPULATION (3 HOURS)**

Series and Data frames in Pandas – Data Loading - Indexing – Data cleaning and preprocessing - Data Manipulation: Sorting, grouping, handling missing values - statistical operations in data frames.

**Unit V DATA VISUALIZATION AND STATISTICS (3 HOURS)**

Data visualization using Matplotlib: line, bar, scatter, pie, histogram, multiplots; Descriptive Statistics - Correlation Analysis.

**SUGGESTED EXPERIMENTS:**

1. Develop a program to classify students as Excellent, Good, Average, or At Risk using conditional statements.
2. Develop a program to count the number of days with sales above the average using iterative statements.
3. Develop a recursive function to normalize a dataset using Min–Max normalization.
4. Develop a program using strings to count the number of valid and invalid emails.
5. Develop a program to remove duplicate values from a list and sort the cleaned data in ascending order.
6. Develop a program using tuples to store the customer transaction data and compute the total transaction amount.
7. Develop a program to store account number as key and customer details (name, balance, account type) as values using dictionaries and update account balance after deposit or withdrawal.
8. Develop a program to read transaction details from a CSV file and write suspicious transactions to a separate file.
9. A dataset contains monthly sales figures stored in a NumPy array. Develop a program to extract sales data for a specific range of months and access rows and columns using slicing.
10. A dataset of customer balances is stored in a NumPy array. Develop a program to compute quartiles (Q1, Q2, Q3) and interquartile range (IQR).
11. Loan applicant data includes income, age, and credit score is stored in a CSV file. Filter applicants satisfying multiple conditions (e.g., income > ₹50,000 and credit score > 700) using Pandas.
12. A bank wants to visually analyze customer, transaction, and revenue data to support decision-making. Develop a Python application that uses different Matplotlib plots to represent various types of data.
13. Mini Project on Exploratory Data Analysis.

**TEXTBOOKS:**


1. S Sridhar, J Indumathi, V M Hariharan, "Python Programming", Pearson, 2023. (UNIT I, II).
2. Allen B. Downey, “Think Stats: Exploratory Data Analysis” 3rd edition, O'Reilly, 2025 (UNIT III, IV, V).


**REFERENCE BOOKS:**


1. Wes McKinney, "Python for Data Analysis", O'Reilly, 2022 (Unit V)
2. Allen B. Downey, ``Think Python", 3rd edition, O'Reilly Media, 2024, Online Version: https://allendowney.github.io/ThinkPython/
3. Ron S. Kenett, Shelemyahu Zacks, Peter Gedeck, "Modern Statistics: A Computer-Based Approach with Python", Springer, 2022.
4. Karl Beecher, ``Computational Thinking – A beginner's Guide to Problem Solving and Programming", British Computer Society (BCS), 2017.

5. John V Guttag, ``Introduction to Computation and Programming Using Python", 3rd edition, MIT Press, 2021.
6. Alan Agresti and Maria Kateri, ``Foundations of Statistics for Data Scientists With R and Python ", First Edition, CRC Press, 2022.

**COURSE OUTCOMES:**

| | Course Outcomes | Knowledge Level |
|---|---|---|
| **CO1** | Apply sequential, alternate, and iterative approaches for solving problems. | KL3 |
| **CO2** | Solve problems by using different datatypes and files. | KL3 |
| **CO3** | Develop Python programs for numerical computations using NumPy | KL3 |
| **CO4** | Develop Python programs for data manipulation using Pandas. | KL3 |
| **CO5** | Select appropriate Matplotlib visualization techniques to accurately represent data trends, patterns, and analytical outcomes. | KL5 |

| Course Code | Category | MAKERS SPACE LABORATORY | L | T | P | C | Contact Hours |
|---|---|---|---|---|---|---|---|
| | SEC | | 0 | 0 | 4 | 2 | 4 |
| Course Level | | *Prerequisite Courses: Nil* | | | | | |

**COURSE OBJECTIVES:**

- To provide hands-on experience to the students in various basic engineering practices in Mechanical and Civil Engineering
- To provide hands-on training to the students in electrical wiring practices and the use of electronic components.

**LIST OF EXPERIMENTS:**

**Mechanical & Civil Engineering Practice**

1. **Makers Lab Safety & Tool Handling:** Lab orientation, workflow, PPE, power tool safety, material handling, measurement and marking, Outcome*:* Safe operation of makers lab tools.
2. **Power Tool Carpentry – Utility Product Fabrication:** Cutting, drilling, sanding, joint preparation. *Fabrication:* **Pen stand/utility box,** *Outcome:* Confidence in real carpentry operations.
3. **Carpentry Joints & Building Components:** Fabrication using lap and mortise–tenon joints. *Fabrication:* **Mini door/window frame or wall shelf,** *Outcome:* Understanding structural wood joints used on site.
4. **Plumbing Practice – Domestic Water Supply:** Pipe cutting, joining, and fitting (PVC & GI). *Fabrication:* **Wash basin plumbing system,** *Outcome:* Knowledge of household plumbing installation.
5. **Plumbing System Layout & Drainage:** Assembly of supply and drainage lines. *Fabrication:* **Mini water distribution / sanitary line model,** *Outcome:* Understanding real building plumbing layouts.
6. **Machining Practice – Functional Metal Component:** Drilling, tapping, countersinking, and work holding. *Fabrication:* **Fixture plate/tool holder,** *Outcome:* Exposure to workshop machining operations.
7. **Sheet Metal Fabrication – Industrial Product:** Cutting, bending, folding, riveting. *Fabrication:* **Mobile stand / small enclosure/duct prototype:** *Outcome:* Sheet metal fabrication skills.

8. **Mechanical Mechanism Models:** Assembly and study of motion systems. *Models:* **Gear train, belt-pulley, slider-crank, scissor mechanism.** *Outcome:* Practical understanding of motion transmission.
9. **Real-Life Mechanical Systems Study:** Hands-on observation and disassembly. *Systems:* **Hand pump, flush tank, pedestal fan mechanism.** *Outcome:* Linking theory with real engineering products.
10. **3D Printing – Engineering Prototyping:** Design and fabrication using additive manufacturing. *Fabrication:* **Mechanical bracket / civil pipe or truss model,** *Outcome:* Exposure to modern manufacturing practices.
11. **Laser Cutting & Hybrid Fabrication:** Laser cutting of wood/acrylic and integration with other materials. *Fabrication:* **Building layout plate/phone stand,** *Outcome:* Understanding digital fabrication workflows.

**Electrical & Electronics Engineering Practice**

1. **Domestic Electrical Wiring Practice:** Assemble a single-phase domestic wiring circuit for operating household appliances using fuse, switch, lamp, energy meter and test its operation. *Outcome***:** Demonstrate domestic electrical wiring practices.
2. **Electrical Measurements in RLC Circuit**: Assemble a single-phase RLC circuit and measure electrical quantities-voltage, current, power, and power factor. *Outcome*: Understand the practical measurement of electrical quantities in RLC circuit.
3. **Electrical Fault Simulation and Protection:** Identifying and analyzing common electrical faults. *Outcome:* Understand electrical faults, working of protective devices, and earthing systems for electrical safety.
4. **Soldering Practice**: Assembly and testing of mobile phone charging circuit. *Outcome:* Hands-on skill in soldering, component identification, and testing.
5. **Relay Control Circuit Using Logic Gates:** Assembly and testing of a relay-based control circuit using logic gates. *Outcome:* Understand the operation of a relay control circuit using logic gates.
6. **AC signal Parameters Measurement and Analysis**: Measurement of amplitude and frequency in a rectifier circuit using a CRO. *Outcome:* Understand the usage of CRO and measurement of AC signal parameters.

7. **Sensor and Actuator Interfacing:** Integration of sensors and actuators with a microcontroller. *Outcome:* Understand the programming of embedded controller for interfacing sensors and actuators.

8. **Dis-assembly and assembly of electrical home appliances**: Grinder Mixer, Ceiling Fan. *Outcome:* Hands-on skill in disassembling, assembling of domestic electrical appliances.

**REFERENCE BOOKS**


1. S Gowri, T Jeyapoovan, "Engineering Practices Laboratory Manual", 5th Edition, Vikas Publishing, 2016.
2. V Ramesh Babu, "Engineering Practices Laboratory", VRB Publications, 2006.
3. Willis H Wagner, Howard Bud Smith, Mark W Huth, "Modern Carpentry", 12th Edition, 2015.
4. P C Sharma, "Production Technology: Manufacturing Process", S Chand publisher, 2006.
5. David W Rongey, "A Complete Guide to Home Electrical Wiring", 2013.
6. K Jeyachandran, S Natarajan, S Balasubramanian, "A Primer on Engineering Practices Laboratory, Anuradha Publications, 2007.


**COURSE OUTCOMES**

| | Course Outcomes | Knowledge Level |
|---|---|---|
| **CO1** | Identify and explain makers lab safety practices, PPE usage, tools, workflow, and engineering materials used in fabrication. | KL2 |
| **CO2** | To perform carpentry, plumbing, machining, and sheet metal work to fabricate real-time civil engineering components, domestic water supply systems and to manufacture functional mechanical components. | KL3 |
| **CO3** | Apply modern fabrication techniques such as 3D printing and laser cutting to develop mechanical and civil engineering models and prototypes to meet practical engineering requirements. | KL3 |
| **CO4** | Construct electrical circuits and demonstrate their working. | KL3 |
| **CO5** | Demonstrate the implementation and control of electronic circuits for practical applications. | KL2 |

# SEMESTER - II

| Course Code | Category | DIFFERENTIAL EQUATIONS AND COMPLEX FUNCTIONS (Common to ECE, VLSI, BME, CIVIL, EEE, MECH, CHEM) | L | T | P | C | Contact Hours |
|---|---|---|---|---|---|---|---|
| | MC | | 3 | 0 | 0 | 3 | 3 |
| Course Level | | *Prerequisite Courses: Nil* | | | | | |

**COURSE OBJECTIVES:**

The objective of the course is to enable the students

- To understand the concept of ordinary and partial differential equations and utilize it in solving engineering problems.
- Find the Laplace Transforms of standard functions and solve second order linear ordinary differential equations with constant coefficients.
- To construct Analytic functions and evaluate integrals using Cauchy's integral formula.

**UNIT I ORDINARY DIFFERENTIAL EQUATIONS (9 HOURS)**

Solution of second and higher order linear differential equations with constant coefficients (RHS functions - $e^{mx}, sinmx, cosmx, x^n, x^n f(x),\ e^{mx} f(x)$), Application to harmonic oscillation of an undamped Mass-Spring system- Method of variation of parameters - Simultaneous linear differential equations with constant coefficients of first order.

**UNIT II LAPLACE TRANSFORMS (9 HOURS)**

Definition, properties – Transform of elementary functions, unit step function and unit impulse function, shifting theorems – Transforms of derivatives and integrals, Evaluation of integrals by Laplace transforms - Periodic functions – Initial and final value theorems.

**UNIT III INVERSE LAPLACE TRANSFORMS (9 HOURS)**

Inverse transforms – Definition, Properties - Method of Partial Fractions, Inverse Laplace transforms of derivatives and integrals - Convolution theorem - Applications of Convolution Theorem - Ordinary Differential Equations: Solution by using Laplace Transforms.

**UNIT IV ANALYTIC FUNCTIONS (9 HOURS)**

Analytic functions – necessary and sufficient conditions, Cauchy-Riemann equations in Cartesian and polar form (with proof) – Properties – harmonic functions, Construction of analytic function, conformal mapping – some standard transformations w = z + c, cz, 1/z, bilinear transformation.

**UNIT V COMPLEX INTEGRATION (9 HOURS)**

Line integral – Cauchy's integral theorem – Cauchy's integral formula, Taylor's and Laurent's series, Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour (except the poles on the real axis).

**TEXTBOOKS**

1. Grewal B.S, Higher Engineering Mathematics, Khanna Publishers, 45th Edition, 2020.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, Inc., 10th Edition, 2020.

**REFERENCE BOOKS**


1. Bali, N.P., Goyal, M., Watkins, C., Advanced Engineering Mathematics, Laxmi Publications Pvt. Limited, 2007.
2. Boyce, W.E., and DiPrima, R.C., Elementary Differential Equations and Boundary Value Problems, Wiley India, 2012.
3. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass, Thomas' Calculus: Early Transcendental, 13th Edition, Pearson Education, 2013.
4. O'Neil. P. V., Advanced Engineering Mathematics, 7th Edition, Cengage Learning India Pvt., Ltd, New Delhi, 2011.
5. Howard Anton, Irl C. Bivens, Stephen Davis, Calculus Early Transcendentals, 11th Edition, John Wiley & Sons, Inc., 2016.


**COURSE OUTCOMES**

| | Course Outcomes | Knowledge Level |
|---|---|---|
| **CO1** | Solve second- and higher-order linear ordinary differential equations with constant coefficients, handle simultaneous linear ODEs. | KL4 |
| **CO2** | Obtain the Laplace Transforms of standard functions. | KL4 |
| **CO3** | Apply the concepts of inverse Laplace Transforms in solving differential equations. | KL3 |
| **CO4** | Solve problems in Analytic functions and construction of analytic functions using C-R equations | KL3 |
| **CO5** | Compute line integrals, residues, and real integrals via residue theorems. | KL3 |

| Course Code | Category | TECHNICAL WRITING | L | T | P | C | Contact Hours |
|---|---|---|---|---|---|---|---|
| | AEC | | 2 | 0 | 2 | 3 | 4 |
| Course Level | | *Prerequisite Courses: Nil* | | | | | |

**COURSE OBJECTIVES:**

- To prepare effective instructions, checklists and emails.
- To write different kinds of paragraphs and argumentative essays
- To develop and revise effective resumes, cover letters and SOPs.
- To document and organise various kinds of reports, case studies and white papers.
- To create well-structured proposals and press releases.

**UNIT I WRITING INSTRUCTIONS, CHECKLISTS AND EMAILS (12 HOURS)**

Writing instructions and checklists; using bulleted lists and numbered lists. Writing professional emails: appropriate greetings, subject line, writing three-body paragraphs – introduction, body, and closing paragraph; discussion of samples. Language skills: Tenses – present and past.

**UNIT II WRITING ARGUMENTATIVE PARAGRAPHS AND ESSAYS (12 HOURS)**

Writing paragraphs. Structure of a paragraph: basic, compare and contrast. Product descriptions and process descriptions. Interpreting charts and graphs. Writing argumentative essays; handling three types of arguments: Classical, Rogerian, Toulmin; structure of an argumentative essay: introduction, building the thesis, body paragraphs with three arguments or claims and supporting evidence, conclusion. Sample essays.
Language skills: Connectors and definitions

**UNIT III WRITING JOB APPLICATIONS AND SUMMARIE (12 HOURS)**

Writing job applications; resumes and cover letters. Writing the statement of purpose (SOP): Outline – professional narrative, previous experience, research interests, and career goals. Writing summaries: reading the text; identifying the main ideas and supporting details. Writing paraphrases: step by step paraphrasing; text comparison; sentence analysis.
Language skills: subject-verb agreements.

**UNIT IV WRITING REPORTS, CASE STUDIES AND WHITE PAPERS (12 HOURS)**

Writing datasheets: outline – descriptions, graphics, benefits, features and specifications, requirements, and contact information. Writing abstracts. Writing technical reports; practising IMRAD structure; Engineering reports & Feasibility reports. Writing case studies and white papers:

main components of an issue case study – problems, search for solutions, implementation of the solution and results.
Language skills: Active voice, passive voice.

**UNIT V WRITING PROPOSALS AND PRESS RELEASES (12 HOURS)**

Writing business proposals: format -- title page, table of contents, executive summary, project details, deliverables and milestones, budget, conclusion. Writing for Websites: Inverted pyramid style; headings and subheading; bulleted lists; short paragraphs with one idea. Writing press releases: outline – headline, date of publication, contact information, summary, intro paragraph, detail paragraphs, and about section.
Language skills: Correction of errors, proofreading and editing.

**TEXTBOOKS:**


1. Laplante, P. A. (2018). *Technical writing: A practical guide for engineers, scientists, and nontechnical professionals*. CRC Press.
2. David Bonamy. (2013) Technical English Level 2 Course Book. Pearson


**REFERENCES:**


1. Kmiec, D., & Longo, B. (2017). *The IEEE guide to writing in the engineering and technical fields*. John Wiley & Sons.
2. Lewis Lansford; Peter Astley. (2013). Oxford English for Careers: Engineering 1: Student's Book. Oxford University Press.
3. Mark Ibbotson. (2008). Cambridge English for Engineering, 2008, Cambridge University Press.
4. Rubens, P. (2002). *Science and technical writing: A manual of style*. Routledge.


**COURSE OUTCOMES**

| | Course Outcomes | Knowledge Level |
|---|---|---|
| **CO1** | Write instructions, checklists and emails with clarity and readability. | KL3 |
| **CO2** | Compose paragraphs, and structure an argumentative essay effectively. | KL4 |
| **CO3** | Create and edit resumes, cover letters and SOPs concisely. | KL4 |
| **CO4** | Document well-structured reports, case studies and white papers. | KL5 |
| **CO5** | Develop effective proposals and press releases. | KL5 |

| Course Code | Category | ENGINEERING PHYSICS (Common to CIVIL, MECHANICAL, CHEMICAL and BME) | L | T | P | C | Contact Hours |
|---|---|---|---|---|---|---|---|
| | MD | | 3 | 0 | 2 | 4 | 5 |
| Course Level | | *Prerequisite Courses: Nil* | | | | | |

**COURSE OBJECTIVES:**

The objective of this course is to enable the student to

- Comprehend and identify different crystal structures and their imperfections.
- Develop an understanding of quantum mechanical phenomena and their applications.
- Explain physics of semiconductors.
- Provide an overview of the characteristics of sound, architectural acoustics and the production and applications of ultrasound.
- Understand the origin of laser action, production of laser, fibre optics and their applications.

**UNIT I CRYSTAL PHYSICS (9 HOURS)**

Single crystalline, polycrystalline (common metals/alloys) and amorphous materials– single crystals - Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures (qualitative treatment) - Crystal Imperfections with Examples – Point, line (Edge and Screw dislocations –Burger vectors) Surface (stacking faults) and Volume defects-Crystals in scintillation detectors (CsI, LSO, BGO and NaI).

**LABORATORY EXPERIMENT**

1. Determination of the Young's modulus of the given metal/alloy.

**UNIT II QUANTUM PHYSICS (9 HOURS)**

Black body radiation – Planck's radiation law (Qualitative) – Deduction of Wien's displacement law and Rayleigh – Jeans' Law from Planck's theory – Compton Effect (Conceptual)– Photoelectric effect (conceptual)- Properties of Matter waves – wave particle duality - Schrödinger's wave equations – Time independent and time dependent equations – Physical significance of wave function – Particle in a one dimensional box and extension to three dimensional box – Degeneracy of electron energy states – Applications-Scanning electron microscopy(SEM)-Transmission electron microscopy(TEM).

**LABORATORY EXPERIMENT**

2. Determination of the Planck's constant and the work function using photoelectric effect.

**UNIT III SEMICONDUCTORS (9 HOURS)**

Classification of semiconductors based on doping and band gap – Intrinsic semiconductor – Concept of hole – carrier concentration derivation –Fermi level and its variation with temperature – electrical conductivity – band gap determination –Extrinsic semiconductors – Carrier concentration derivation in n-type and p-type semiconductors – Variation of Fermi level with temperature and impurity concentration.

**LABORATORY EXPERIMENTS**

3. Determination of the band gap of a semiconductor.

**UNIT IV ACOUSTICS AND ULTRASONICS (9 HOURS)**

**Acoustics:** Classification and characteristics of Sound - decibel - Weber–Fechner law– Sabine's formula (conceptual) —factors affecting the acoustics of buildings and their remedies.

**Ultrasonics**: Production of ultrasonics by Magnetostriction and Piezoelectric methods – acoustic grating -Non-Destructive Testing – pulse echo system through transmission and reflection modes-A, B, C and M– scan displays- Phased Array Ultrasound and Time of Flight Diffraction techniques.

**LABORATORY EXPERIMENTS**

4. Determination of the velocity of sound in the given liquid and compressibility of the liquid using an Ultrasonic interferometer.

**UNIT V LASERS AND FIBRE OPTICS (9 HOURS)**

**Lasers:** Spontaneous and stimulated emission- Population inversion -Einstein's A and B coefficients –Conditions for Laser action - Types of lasers (Qualitative) – Nd: YAG, Basics of diode lasers-Industrial and Medical Applications.

**Fiber optics:** Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – Fibre Optical Communication system (Block diagram) - Applications- Active and passive fiber sensors - pressure and temperature-fiber optic endoscopy.

**LABORATORY EXPERIMENTS**

5. Determination of the grating element/wavelength, and the particle size using a laser.
6. Determination of the numerical aperture and acceptance angle of the given optical fibre.

**TEXTBOOKS:**


1. Gaur, R.K., and Gupta, S.L., Engineering Physics, Dhanpat Rai Publishers, 2012.
2. S. Singaravadivelu and A. Chandrasekaran, Engineering Physics, Vedha Publications, Chennai, 2022.
3. Serway, R.A., & Jewett, J.W., Physics for Scientists and Engineers, Cengage Learning, 2010.
4. Shatendra Sharma and Jyotsna Sharma, "Engineering Physics", Pearson, 2006.


**REFERENCE BOOKS:**


1. Halliday, D., Resnick, R. & Walker, J. Principles of Physics, Wiley, 2015.
2. Tipler, P.A. & Mosca, G. Physics for Scientists and Engineers with Modern Physics, WH Freeman, 2007.
3. Avadhanulu, M. N., Kshirsagar, P. G, A textbook of Engineering Physics, S. Chand &Co. Ltd., Ninth Revised Edition, 2012.
4. H.K. Malik and A. K. Singh, Engineering Physics, 2nd Edition, McGraw Hill, 2016.
5. Pandey B.K., Chaturvedi S. “Engineering Physics”, Cengage Learning India Pvt. Ltd, 2012.


**COURSE OUTCOMES**

| | Course Outcomes | Knowledge Level |
|---|---|---|
| **CO1** | Analyze crystal structures and the influence of imperfections on their properties. | KL4 |
| **CO2** | Comprehend the quantum mechanical principles to correlate with experimental results and their applications. | KL2 |
| **CO3** | Analyze the physics of semiconductors. | KL4 |
| **CO4** | Analyze the applications of acoustics and ultrasonics to engineering and medical disciplines. | KL4 |
| **CO5** | Elucidate the principle and working of lasers and optical fibers, and their applications in the field of industry, medicine and telecommunication | KL2 |

| Course Code | Category | ENVIRONMENTAL SCIENCE | L | T | P | C | Contact Hours |
|---|---|---|---|---|---|---|---|
| | VAC | | 2 | 0 | 0 | 2 | 2 |
| Course Level | | *Prerequisite Courses: Nil* | | | | | |

**COURSE OBJECTIVES:**

This course aims to:

1. To develop a better understanding of human relationship with environment.
2. To explain the importance of conservation of resources.
3. To create awareness on pollution and environmental degradation.
4. To acquire knowledge on sustainable development.
5. To apply technical skills for solving environmental problems.

**UNIT I ECOSYSTEM AND BIODIVERSITY (6 HOURS)**

Structure and function of an ecosystem – energy flow- food chains, food webs and ecological pyramids – ecological succession. Introduction to biodiversity definition and types– values of biodiversity – threats to biodiversity-conservation of biodiversity: In-situ and ex-situ conservation of biodiversity; role of individuals and communities in biodiversity conservation.

**UNIT II NATURAL RESOURCES (6 HOURS)**

Forest, Water, Food, Energy, Mineral and Land resources – uses and case studies on over exploitation of natural resources; Conservation of natural resources; Equitable use of resources for sustainable lifestyles

**UNIT III CURRENT ENVIRONMENTAL AND SOCIAL ISSUES (6 HOURS)**

Air pollution – particulate pollution (Smog, acid rain, climate change and global warming, ozone layer depletion); Water pollution; Soil pollution and solid waste management; Noise pollution; Nuclear pollution; Role of an individual in the prevention of pollution. Disaster management; Human health and Environment: Issues with water and sanitation; Human rights, HIV/AIDS, Women and child welfare

**UNIT IV SUSTAINABLE DEVELOPMENT AND ENVIRONMENTAL GOVERNANCE (6 HOURS)**

Sustainable development goals (SDGs): Origin, Purpose, importance, and challenges in achieving SDG; Circular economy (4 R and 10 R); Upcycling and waste to wealth strategies; Extended

Producer Responsibility; Green buildings; Electric and hybrid electric vehicles; Mission LiFE and Sustainable Lifestyle Practices; Environmental legislations: National Green Tribunal; National missions and policies towards SDGs; ESG framework and corporate sustainability

**UNIT V ENGINEERING INTERVENTION TO REDUCE ENVIRONMENTAL STRESSES (6 HOURS)**

Role of technology in environmental studies – AI and IoT- Real time data collection and analysis - Environmental modelling and simulation – GIS - Remote sensing – satellite and sensors - Use of drone for aerial mapping and surveying.

**TEXTBOOKS**


1. Anubha Kaushik and Kaushik, C. P. "Environmental Science and Engineering", New Age International Publishers, 14thEdition, 2014.
2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.


**REFERENCE BOOKS**


1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
2. Tyler Miller G. , and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014
3. M.H. Fulekar, Bhawana Pathak and R. K. Kale, 'Environment and sustainable development' Springer Nature, 2013.


**COURSE OUTCOMES**

| | Course Outcomes | Knowledge Level |
|---|---|---|
| **CO1** | Acquire the basic concepts of ecosystems; understand the importance of biodiversity and conservation strategies. | KL2 |
| **CO2** | Develop knowledge on natural resources and equitable use of natural resource. | KL2 |
| **CO3** | Analyse the current environmental and social problems and its plausible solutions. | KL2 |
| **CO4** | Explain the concept of sustainable development, its importance and key challenges in implementation of sustainable goals. | KL2 |
| **CO5** | Describe the role of technology for assessment and management of environment and human health. | KL2 |

| Course Code | Category | ENGINEERING THERMODYNAMICS | L | T | P | C | Contact Hours |
|---|---|---|---|---|---|---|---|
| | MC | | 3 | 0 | 0 | 3 | 3 |
| Course Level | | *Prerequisite Courses: Nil* | | | | | |

**COURSE OBJECTIVES:**

- Provide students with a lasting and solid understanding of the fundamentals of thermodynamics.
- Equip students to estimate or locate necessary thermodynamic data and solve thermodynamics problems.

**UNIT I BASIC CONCEPTS (9 HOURS)**

Scope of Thermodynamics: Definition of System, Control Volume, State, and Path Function, Equilibrium, Reversibility, Energy, Work, and Heat. Zeroth Law; Internal Energy, Enthalpy Temperature Scales. Joule's Experiment, First Law of Thermodynamics, Mass and Energy Balance for Closed Systems, and Open Systems,

**UNIT II PVT BEHAVIOUR OF FLUIDS (9 HOURS)**

PVT Behaviour of Fluids; P–v diagram, T–v diagram, P–T diagram, Properties of Fluids Using Steam Tables and Others, Graphical Representation, Mathematical Representation of Ideal & Non-Ideal Equations, Generalized Compressibility Factor Correlation, Generalized Equations of State.

**UNIT III LAWS OF THERMODYNAMICS (9 HOURS)**

Second Law of Thermodynamics, Kelvin–Planck statement, Clausius statement, Heat Engine, Heat Pump and Refrigerator, Carnot Cycle and Carnot Theorems, Entropy of Ideal Gas and Various Process Conditions, Clausius theorem, Clausius inequality, Third Law of Thermodynamics.

**UNIT IV THERMODYNAMIC PROPERTIES RELATIONS (9 HOURS)**

Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibbs Free Energy, Thermodynamic Property Relations & Basic Mathematics. Maxwell Relations and Jacobian Method, Residual Properties, Thermodynamic Property Tables and Diagrams

**UNIT V THERMODYNAMIC CYCLES (9 HOURS)**

Duct Flow of Compressible Fluids, Compression and Expansion Processes, Steam Power Plant, Internal Combustion Engines, Jet and Rocket Engines.

**TEXTBOOKS**


1. Smith, J.M., Van Ness, H.C. and Abbot, M.M. "Introduction to Chemical Engineering Thermodynamics, McGraw-Hill Publishers, VI edition, 2003
2. Narayanan, K.V. A Textbook of Chemical Engineering Thermodynamics, Prentice Hall India, 2004


**REFERENCES BOOKS**


1. Kyle, B.G., "Chemical and Process Thermodynamics III Edition", Prentice Hall of India Pvt. Ltd., 1999.
2. Elliott J.R., Lira, C.T., "Introductory chemical engineering thermodynamics", Prentice Hall,1998
3. Rao, Y.V.C., "Chemical Engineering Thermodynamics" Universities Press, 2005.


**COURSE OUTCOMES**

| | Course Outcomes | Knowledge Level |
|---|---|---|
| **CO1** | Summarize the Basic Concepts of Chemical Engineering Thermodynamics. | KL2 |
| **CO2** | Calculate the Properties of Pure Components Using Steam Table & Equations. | KL3 |
| **CO3** | Apply The Law of Thermodynamics to Closed and Open Systems. | KL4 |
| **CO4** | Develop The Fundamental Thermodynamic Property Relations. | KL5 |
| **CO5** | Apply Mass, Energy, and Entropy Balances to Flow Processes. | KL4 |
| **CO6** | Construct Tables and Charts for Thermodynamic Properties. | KL6 |

| Course Code | Category | PRINCIPLES OF ELECTRICAL AND ELECTRONICS ENGINEERING | L | T | P | C | Contact Hours |
|---|---|---|---|---|---|---|---|
| | MC | | 2 | 0 | 2 | 3 | 4 |
| Course Level | | *Prerequisite Courses: Nil* | | | | | |

**COURSE OBJECTIVES:**

1. To understand DC and AC electrical circuits.
2. To Understand construction and working of Electrical Machines (Both AC and DC) and basic electronic components and circuits.

**UNIT I DC CIRCUITS (6 HOURS)**

DC Circuits: Ohm's Law- Kirchhoff's laws - Mesh current and Node voltage methods (Analysis with only independent source), Source transformation method, Network theorems - Superposition theorem, Thevenin's theorem and Norton's theorem.

**UNIT II AC CIRCUITS (6 HOURS)**

AC circuit: Fundamentals, Waveforms, RMS value, Phasor diagram, Power, Power factor, Solution to RLC single-phase series circuits.
Three phase supply – Star & Delta connection (source and load) – Balanced Loads - Power in three-phase systems.

**UNIT III DC MACHINES & TRANSFORMER (6 HOURS)**

DC Machines: Construction & working principle, Different types (PMDC, Series & Shunt) with their corresponding governing equations, EMF and Torque equation, Characteristics of DC Shunt Machines, Speed Control (shunt motor only).
Transformer: Principle of operation, Construction, Types-core type, and shell type. Phasor diagram – Ideal & Practical Transformer on no load, Equivalent Circuit, Voltage Regulation, Losses & Efficiency.

**UNIT IV AC MACHINES (6 HOURS)**

Three-phase Induction motors – Construction, Principle of operation, Different types, concept of slip and basic governing equations. Single phase Induction motors – Construction, working principal, and different types (basic concepts with circuits only). Synchronous Machines - Construction, working principle, EMF equation, and regulation of Alternator. Working principle & starting methods of Synchronous motor.

**UNIT V ELECTRONIC DEVICES AND CIRCUITS (6 HOURS)**

Operation of PN junction diodes, VI characteristics, Zener diode, BJT- CB, CE, CC configurations, input and output characteristics.
Half wave and full wave rectifier, capacitive filters, Zener voltage regulator, Operational amplifiers, Ideal Op-Amp characteristics, Inverting and Non-inverting amplifier.

**LIST OF EXPERIMENTS**

1. Simulation of electrical circuit by superposition, Thevenin's and Norton's theorem using MATLAB / Simulink and its practical verification.
2. Simulation of AC series circuit to obtain the condition of resonance using MATLAB / Simulink and its practical verification.
3. Open circuit and load characteristics of DC shunt generator.
4. Speed control of DC shunt motor.
5. Open circuit and short circuit tests on single phase transformer.
6. Load test on single phase induction motor.
7. Speed control of three phase slip ring induction motor.
8. Verification of VI-characteristics of PN junction diode & Zener diode.
9. Verification of input-Output characteristics of BJT in CE mode of operation.
10. Design of voltage regulator circuit using Zener diode.
11. Verification of inverting and non-inverting characteristics of an amplifier

**TEXTBOOKS:**


1. Kothari D.P and Nagarath, I.J, "Basic Electrical and Electronics Engineering", McGraw Hill Education (India), 3rd Reprint, 2016.
2. Giorgio Rizzoni, "Principles and Applications of Electrical Engineering", McGraw Hill Education (India), 5th edition, 2017.
3. Salivahanan S., Rengaraj R. and Venkatakrishnan G.R., "Basic Electrical Electronics and Measurement Engineering", McGraw Hill Education (India), 1st Edition, 2018.


**REFERENCES:**


1. Bhattacharya S.K, "Basic Electrical and Electronics Engineering", Pearson India, 2nd edition, 2017.
2. Del Toro, "Electrical Engineering Fundamentals", Prentice Hall of India, 2nd edition, 1989.
3. Leonard S Bobrow, "Foundations of Electrical Engineering", Oxford University Press, 1st Asian edition 2013.
4. Rajendra Prasad, "Fundamentals of Electrical Engineering", Prentice Hall of India, 2nd edition, 2009.
5. Fitzgerald A.E, David E Higginbotham, and Arvin Grabel, "Basic Electrical Engineering", McGraw Hill Education (India), 5th edition, 2009.

**COURSE OUTCOMES**

| | Course Outcomes | Knowledge Level |
|---|---|---|
| **CO1** | Apply Ohm's law, Kirchhoff's laws, and network theorems to analyze basic DC circuits. | KL3 |
| **CO2** | Analyze single-phase and three-phase AC circuits to determine different AC parameters. | KL4 |
| **CO3** | Examine the basic concepts of DC machines and transformers to analyze their characteristics and performance | KL4 |
| **CO4** | Apply the basic concepts of AC machines to select a suitable machine for different engineering applications. | KL3 |
| **CO5** | Apply the concepts of basic electronic devices to understand their application in simple electronic circuits. | KL3 |
| **CO6** | Design and develop a simple engineering circuit using the concepts of electrical and electronics engineering. | KL6 |

| Course Code | Category | SOLID MECHANICS FOR TECHNOLOGIST | L | T | P | C | Contact Hours |
|---|---|---|---|---|---|---|---|
| | MC | | 3 | 0 | 0 | 3 | 3 |
| Course Level | | *Prerequisite Courses: Nil* | | | | | |

**COURSE OBJECTIVES:**

1. To provide students with a clear understanding of the fundamental concepts of stress, strain, deformation, and material behaviour under various types of loading.
2. To develop the ability to determine internal forces, stresses, deflections, and stability characteristics of structural members such as beams, shafts, springs, and columns.

**UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS (9 HOURS)**

Rigid bodies and deformable solids – forces on solids and supports – equilibrium and stability – strength and stiffness – tension, compression and shear stresses – Hooke's law and simple problems– compound bars – thermal stresses – elastic constants and Poisson's ratio.

**UNIT II TRANSVERSE LOADING ON BEAMS (9 HOURS)**

Beams –support conditions–types of Beams –transverse loading on beams–shear force and bending moment in beams–analysis of cantilevers, simply – supported beams and over hanging beams – relationships between loading, S.F. and B.M. In beams and their applications– S.F.& B.M. diagrams.

**UNIT III DEFLECTIONS OF BEAMS (9 HOURS)**

Double integration method – Macaulay's method –Area – moment theorems for computation of slopes and deflections in beams.

**UNIT IV STRESSES IN BEAMS (9 HOURS)**

Theory of simple bending – assumptions and derivation of bending equation (M/I=F/Y= E/R)– analysisofstressesinbeams–loadscarryingcapacityofbeams–proportioning beam sections – leaf springs – flitched beams – shear stress distribution in beams – determination of shear stress in flanged beams.

**UNIT V TORSION AND COLUMNS (9 HOURS)**

Torsion of circular shafts – derivation of torsion equation (T/J = fs/R = Cθ/L) – stress and deformation in circular and hollow shafts – stresses and deformation in circular and hollow shafts– stepped shafts– shafts fixed at both ends– stresses in helical springs–deflection of springs–spring constant. Axially loaded short columns–columns of unsymmetrical sections– Euler's theory of long columns – critical loads for prismatic columns with different end conditions – effect of eccentricity.

**TEXTBOOKS:**


1. Bansal, R.K., Strength of Materials, 7th Edition, Laxmi Publications (P) Ltd., New Delhi, 2022.
2. Hibbeler, R.C., Mechanics of Materials, 10th Edition, Pearson Education, 2020.
3. Beer, F.P., Johnston Jr., E.R., DeWolf, J.T., and Mazurek, D.F., Mechanics of Materials, 8th Edition, McGraw Hill Education, 2020.


**REFERENCES:**


1. Gere, J.M. and Goodno, B.J., Mechanics of Materials, 9th Edition, Cengage Learning, 2018.
2. Popov, E.P. and Balan, T.A., Engineering Mechanics of Solids, 2nd Edition, Pearson Education, 2019.
3. Ugural, A.C. and Fenster, S.K., Advanced Strength and Applied Elasticity, 6th Edition, Pearson Education, 2020.


**COURSE OUTCOMES**

| | Course Outcomes | Knowledge Level |
|---|---|---|
| **CO1** | Explain the behaviour of rigid and deformable bodies and determine stresses and strains developed due to axial loads, shear forces, and temperature changes. | KL2 |
| **CO2** | Determine shear force and bending moment distributions for beams subjected to different support conditions and loading arrangements. | KL3 |
| **CO3** | Compute slopes and deflections of beams using standard analytical methods such as double integration, Macaulay's method, and area–moment theorems. | KL3 |
| **CO4** | Estimate bending and shear stresses in beams and assess load carrying capacity and section suitability for structural applications. | KL4 |
| **CO5** | Evaluate stresses and deformations in circular shafts and helical springs subjected to torsion and axial loads. | KL4 |
| **CO6** | Demonstrate independent learning and critical thinking by solving advanced solid mechanics problems and interpreting results related to real-life civil engineering components. | KL5 |

| Course Code | Category | CHEMICAL ANALYSIS LABORATORY | L | T | P | C | Contact Hours |
|---|---|---|---|---|---|---|---|
| | MC | | 0 | 0 | 4 | 2 | 4 |
| Course Level | | *Prerequisite Courses: Nil* | | | | | |

**COURSE OBJECTIVES:**

- To make students acquire practical skills in wet chemical practices and analytical methods.
- To create awareness about various experimental practices that help to analyse the composition of certain chemical and related products.
- To educate students about different quantitative techniques used in product analysis.

**List of Experiments**

1. Determination of viscosity of various oils
2. Determination of flash, fire, cloud and pour points of oils.
3. Determination of acid value and iodine value of oils.
4. Determination of COD of water samples.
5. Determination of nitrite and nitrate in water
6. Estimation of Silica, Calcium oxide and mixed oxide content of cement
7. Estimation of sulphur, proximate and ultimate analysis of Coal
8. Estimation of fatty acid, alkali content in soaps.
9. Estimation of protein in food.
10. Determination of glucose content in solutions.
11. Determination of cellulose in plant materials.
12. Determination of calorific value using bomb calorimeter.
13. Determination of Inorganic concentration (sodium, potassium, calcium etc) in the given sample.
14. Determination of sulphate in the given sample.
15. Determination of turbidity in the given water sample.

***Minimum 10 experiments shall be offered***

**COURSE OUTCOMES**

| | Course Outcomes | Knowledge Level |
|---|---|---|
| **CO1** | Apply appropriate analytical techniques to evaluate the properties of fuels, oils, water pollutants, soaps, cement, and biological materials to assess their quality and composition. | KL3 |
| **CO2** | Analyze and propose solutions for industrial and environmental challenges by applying advanced chemical analysis methods to characterize fuels, water pollutants, and engineering materials. | KL4 |