



Curriculum Structure & Detailed Syllabus
Bachelor of Technology
in
Computer Science & Engineering
(Four-Year Under-Graduate Program)

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Approval History

| ACM# | Date | Resolutions |
|-------------|-------------|--|
| SU-1 | 27/04/2024 | The curriculum structure of B.Tech.(CSE) was approved in principle by the Academic Council. |
| SU-2 | 17/08/2024 | The curriculum structure of B.Tech.(CSE) and the detailed syllabus of 1st Year was approved by the Academic Council. |

Knowledge and Attitude Profile (WK's)

Knowledge and Attitude Profile (WK's) are linked to the Graduates Attributes (GAs) which indicate a graduate's potential to acquire competence at the appropriate level. NBA has defined 9 (nine) Knowledge and Attitude Profile (WK's) aligned with the Washington Accord for UG Engineering programs.

- 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 Outcomes (PO's)

Graduates Attributes (GAs) form a set of individually assessable outcomes that are the components indicative of the graduate's potential to acquire competence to practice at the appropriate level. The Program Outcomes (POs) for UG Engineering programs as defined by NBA are:

- 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 & 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)

- PSO1. Understand, analyze, and develop efficient software solutions to problems of varying complexity related to algorithms, system software, multimedia, web applications, data processing, and networking by applying fundamental concepts of computer science.
- PSO2. Develop the skills in different computer languages, environments, tools & platforms to become a successful software professional or entrepreneur, develop a zest for innovation & higher studies, and contribute as a responsible citizen with effective communication, strong moral values and professional ethics.
- PSO3. Adapt to the evolutionary changes in computing and embrace modern practices of software development to deliver user-friendly expert systems with for business success in the real world to meet the challenges of the future.

Program Educational Objectives (PEOs)

- PEO1. *Fundamental Knowledge & Core Competence:* To apply fundamental knowledge of mathematics, science and engineering required for a successful computer professional and inculcate competent problem solving ability using efficient algorithms.
- PEO2. *Proficiency for the Real World:* To foster the skills and creative ability to analyze, design, test and implement cost effective software applications and digital support systems for the changing needs of the real world.
- PEO3. *Leadership & Social Responsibility:* To exhibit leadership capability with professional, ethical, interpersonal skills, social & economic commitment with a sense of responsibility towards public policies, community services, humanity and environment.
- PEO4. *Life-long Learning:* To grow professionally through continued education & training of technical and management skills, pursue higher studies, and engage in life-long learning.

Course Categories & Definitions

| | |
|-----|--|
| L | Lecture |
| T | Tutorial |
| P | Practical / Laboratory / Sessional |
| WCH | Weekly Contact Hours |
| UCR | University Core Course |
| UMC | University Mandatory Course (0-Credit) |
| PCR | Program Core Course |
| PEL | Program Elective Course |
| OEL | Open Elective Course |
| HNS | Honours (Choice-based) Course |
| MNR | Minor (Choice-based) Course |
| OOO | Open Online Course (on NPTEL / Swayam / Other) |
| INT | Summer Internship |
| PSI | Practice School / Industry Internship |
| PRJ | Project Work |
| SEC | Skill Enhancement Course |
| VAC | Value Addition Course |

Contents

| | |
|---|-----------|
| I Curriculum Structure | 1 |
| Induction Program | 2 |
| 1st Year B.Tech.(Common) | 3 |
| Semester I | 3 |
| Semester II | 4 |
| 2nd Year B.Tech.(CSE) | 5 |
| Semester III | 5 |
| Semester IV | 5 |
| 3rd Year B.Tech.(CSE) | 6 |
| Semester V | 6 |
| Semester VI | 6 |
| 4th Year B.Tech.(CSE) | 7 |
| Semester VII | 7 |
| Semester VIII | 7 |
| 4th Year B.Tech.(CSE) - [PS-7] | 8 |
| Semester VII | 8 |
| Semester VIII | 8 |
| 4th Year B.Tech.(CSE) - [PS-8] | 9 |
| Semester VII | 9 |
| Semester VIII | 9 |
| List of Electives | 10 |
| List of Tracks for Honours / Minor | 11 |
| | |
| II Detailed Syllabus | 12 |
| | |
| 1st Year B.Tech. (Common) | 13 |
| Semesters I & II | 13 |
| <i>Theory</i> | 13 |
| ODE & Matrix Algebra | 13 |
| Engineering Chemistry | 15 |
| Engineering Physics | 18 |
| Basic Electronics Engineering | 20 |
| Basic Electrical Engineering | 23 |
| Engineering Mechanics | 25 |
| Engineering Thermodynamics | 27 |
| Computer Programming | 29 |
| Constitution of India & Professional Ethics | 31 |
| Environmental Science & Engineering | 33 |
| Probability & Statistics | 35 |
| Data Structures & Algorithms | 37 |
| <i>Practical</i> | 39 |
| Basic Electronics Engineering Lab | 40 |
| Basic Electrical Engineering Lab | 42 |
| Computer Programming Lab | 44 |
| Communicative & Technical English | 46 |
| Workbench Practices | 49 |
| Engineering Graphics | 52 |
| Data Structures & Algorithms Lab | 54 |

Part I

Curriculum Structure

Induction Program

It is necessary for a newly admitted student to acclimatize to the environment of a college, create a bonding between the teacher and students, equip the students with communication skills, and get them acquainted with the academic & disciplined culture of institution & human values.

All students admitted to B.Tech. programs shall undergo a mandatory induction program after joining the institute and before the commencement of classes. Regular classes of the engineering programs shall begin only after the students have completed the induction program.

The induction program shall comprise of familiarization to the rules & regulations of the institute, examinations & evaluation system, departments/branches, campus facilities, official processes & important officials, curricular/ co-curricular/ extra-curricular activity clubs, innovation & research activities, etc. The program shall also comprise of lectures by eminent persons on adopting a disciplined & healthy life-style, career planning & emerging technologies, social awareness, human values & ethics to sensitize & motivate the students to become not only a successful engineer, but also a socially responsible citizen and contribute their part for social development and nation building.

Interaction with faculty advisors, mentors, senior students, individual/group physical activities, learning or exhibiting an art form/ literature, social service initiatives, and visits to important places of the city, and any other events/ activities deemed to be necessary, may also be included in the induction program.

Every new student must diligently attend & participate in all the activities of the induction program. Attendance in the activities shall be recorded. Students have to submit a daily report in prescribed format to the concerned faculty advisor on the next day. There will be a computer-based test with multiple-choice questions on a suitable date about a week after completion of the induction program.

Evaluation of Induction Program shall be done out of 100 marks, comprising of 3 components, namely: (i) 25 marks for attendance, (ii) 25 marks for the daily reports, and (iii) 50 marks for the computer-based multiple-choice test. A student has to score at least 50 marks in total to pass the induction program.

In case of failure, the student has to attend the induction program in the next academic year along with the newly admitted students, submit daily reports, and appear the computer-based test to score a pass mark.

Curriculum Structure

1st Year B.Tech. (Common)

| Semester I | | | | | | | | |
|------------|--------------------|--|--------------|----------|-----------|------------------|----------|----------|
| Category | Code | Course Title | WCH L-T-P | | | Credits L-T-P | | |
| THEORY | | | | | | | | |
| UCR | MT1001 | ODE & Matrix Algebra | 3 | 0 | 0 | 3 | 0 | 0 |
| UCR | CH1001 / PH1001 | Engineering Chemistry / Engineering Physics | 3 | 0 | 0 | 3 | 0 | 0 |
| UCR | EC1001 / EE1001 | Basic Electronics Engineering / Basic Electrical Engineering | 3 | 0 | 0 | 3 | 0 | 0 |
| UCR | ME1001 / ME1002 | Engineering Mechanics / Engineering Thermodynamics | 2 | 0 | 0 | 2 | 0 | 0 |
| UCR | CS1001 | Computer Programming | 3 | 0 | 0 | 3 | 0 | 0 |
| UMC | HS0001 / CH0001 | Constitution of India & Professional Ethics / Environmental Science & Engineering | 3 | 0 | 0 | 0 | 0 | 0 |
| PRACTICAL | | | | | | | | |
| UCR | EC1002 / EE1002 | Basic Electronics Engineering Lab / Basic Electrical Engineering Lab | 0 | 0 | 2 | 0 | 0 | 1 |
| UCR | CS1002 | Computer Programming Lab | 0 | 0 | 4 | 0 | 0 | 2 |
| SEC | HS1001 | Communicative & Technical English | 0 | 0 | 4 | 0 | 0 | 2 |
| UCR | EE1003 / ME1003 | Workbench Practices / Engineering Graphics | 0 | 0 | 2 | 0 | 0 | 1 |
| | | SUB-TOTAL | 17 | 0 | 12 | 14 | 0 | 6 |
| | | TOTAL | 29 | | | 20 | | |

Note: For some courses, the subjects have been mentioned as Subject-1 / Subject-2, i.e., with an OR option. Every student has to study both the subjects, however allocation of these subjects shall alternate between Semesters I and II. For example, if a student has been allocated *Engineering Chemistry* in Semester-I, then he/she will be allocated *Engineering Physics* in Semester-II, and vice-versa. The laboratory subjects will be as per the theory subjects allocated in the applicable semester. The same applies to all other courses provided with an OR option.

1st Year B.Tech. (Common)

| Semester II | | | | | | | | |
|------------------|--------------------|--|--------------|----------|-----------|------------------|----------|----------|
| Category | Code | Course Title | WCH L-T-P | | | Credits L-T-P | | |
| THEORY | | | | | | | | |
| UCR | MT1002 | Probability & Statistics | 3 | 0 | 0 | 3 | 0 | 0 |
| UCR | PH1001 / CH1001 | Engineering Physics / Engineering Chemistry | 3 | 0 | 0 | 3 | 0 | 0 |
| UCR | EE1001 / EC1001 | Basic Electrical Engineering / Basic Electronics Engineering | 3 | 0 | 0 | 3 | 0 | 0 |
| UCR | ME1002 / ME1001 | Engineering Thermodynamics / Engineering Mechanics | 2 | 0 | 0 | 2 | 0 | 0 |
| UCR | CS1003 | Data Structures & Algorithms | 3 | 0 | 0 | 3 | 0 | 0 |
| UMC | CH0001 / HS0001 | Environmental Science & Engineering / Constitution of India & Professional Ethics | 3 | 0 | 0 | 0 | 0 | 0 |
| PRACTICAL | | | | | | | | |
| UCR | EE1002 / EC1002 | Basic Electrical Engineering Lab / Basic Electronics Engineering Lab | 0 | 0 | 2 | 0 | 0 | 1 |
| UCR | CS1004 | Data Structures & Algorithms Lab | 0 | 0 | 4 | 0 | 0 | 2 |
| SEC | HS1002 | Corporate Communication Skills | 0 | 0 | 4 | 0 | 0 | 2 |
| UCR | ME1003 / EE1003 | Engineering Graphics / Workbench Practices | 0 | 0 | 2 | 0 | 0 | 1 |
| SUB-TOTAL | | | 17 | 0 | 12 | 14 | 0 | 6 |
| TOTAL | | | 29 | | | 20 | | |

Note: For some courses, the subjects have been mentioned as Subject-1 / Subject-2, i.e., with an OR option. Every student has to study both the subjects, however allocation of these subjects shall alternate between Semesters I and II. For example, if a student has been allocated *Engineering Chemistry* in Semester-I, then he/she will be allocated *Engineering Physics* in Semester-II, and vice-versa. The laboratory subjects will be as per the theory subjects allocated in the applicable semester. The same applies to all other courses provided with an OR option.

2nd Year B.Tech.(CSE)

| Semester III | | | | | | | | |
|------------------|------|---|--------------|---|---|------------------|---|---|
| Category | Code | Course Title | WCH L-T-P | | | Credits L-T-P | | |
| THEORY | | | | | | | | |
| PCR | | Discrete Mathematics | 3 | 0 | 0 | 3 | 0 | 0 |
| UCR | | OOP Using Java | 3 | 0 | 0 | 3 | 0 | 0 |
| UCR | | Management & Economics for Engineers / Biology for Engineers | 3 | 0 | 0 | 3 | 0 | 0 |
| PCR | | Design & Analysis of Algorithms | 3 | 1 | 0 | 3 | 1 | 0 |
| PCR | | Operating Systems | 3 | 0 | 0 | 3 | 0 | 0 |
| PCR | | Digital Electronics | 3 | 0 | 0 | 3 | 0 | 0 |
| PRACTICAL | | | | | | | | |
| UCR | | OOP Using Java Lab | 0 | 0 | 2 | 0 | 0 | 1 |
| PCR | | Design & Analysis of Algorithms Lab | 0 | 0 | 2 | 0 | 0 | 1 |
| PCR | | Operating Systems Lab | 0 | 0 | 2 | 0 | 0 | 1 |
| PCR | | Digital Electronics Lab | 0 | 0 | 2 | 0 | 0 | 1 |
| INT | | Summer Internship - I | 0 | 0 | 0 | 0 | 0 | 1 |
| TOTAL | | | 27 | | | 24 | | |

| Semester IV | | | | | | | | |
|-----------------------------------|------|---|--------------|---|---|------------------|---|---|
| Category | Code | Course Title | WCH L-T-P | | | Credits L-T-P | | |
| THEORY | | | | | | | | |
| PCR | | Optimization Techniques | 3 | 0 | 0 | 3 | 0 | 0 |
| UCR | | Programming in Python | 3 | 0 | 0 | 3 | 0 | 0 |
| UCR | | Management & Economics for Engineers / Biology for Engineers | 3 | 0 | 0 | 3 | 0 | 0 |
| PCR | | Computer Organization & Architecture | 3 | 0 | 0 | 3 | 0 | 0 |
| PCR | | Database Management Systems | 3 | 1 | 0 | 3 | 1 | 0 |
| PEL | | Program Elective - I | 3 | 0 | 0 | 3 | 0 | 0 |
| HNS/MNR | | Honours / Minor - I | 3 | 0 | 0 | 3 | 0 | 0 |
| PRACTICAL | | | | | | | | |
| UCR | | Programming in Python Lab | 0 | 0 | 2 | 0 | 0 | 1 |
| PCR | | Database Management Systems Lab | 0 | 0 | 2 | 0 | 0 | 1 |
| PCR | | Computer Organization & Architecture Lab | 0 | 0 | 2 | 0 | 0 | 1 |
| PCR | | Internet & Web Technology Lab | 0 | 0 | 4 | 0 | 0 | 2 |
| TOTAL | | | 29 | | | 24 | | |
| TOTAL (with Honours/Minor) | | | 32 | | | 27 | | |

3rd Year B.Tech.(CSE)

| Semester V | | | | | | | | |
|-----------------------------------|------|-------------------------------------|--------------|---|---|------------------|---|---|
| Category | Code | Course Title | WCH L-T-P | | | Credits L-T-P | | |
| THEORY | | | | | | | | |
| PCR | | Computer Networks | 3 | 1 | 0 | 3 | 1 | 0 |
| PCR | | Machine Learning | 3 | 1 | 0 | 3 | 1 | 0 |
| PCR | | Software Engineering | 3 | 0 | 0 | 3 | 0 | 0 |
| PCR | | Formal Languages & Automata Theory | 3 | 0 | 0 | 3 | 0 | 0 |
| PEL | | Program Elective - II | 3 | 0 | 0 | 3 | 0 | 0 |
| PEL | | Program Elective - III | 3 | 0 | 0 | 3 | 0 | 0 |
| HNS/MNR | | Honours / Minor - II | 3 | 0 | 0 | 3 | 0 | 0 |
| PRACTICAL | | | | | | | | |
| PCR | | Computer Networks Lab | 0 | 0 | 2 | 0 | 0 | 1 |
| PCR | | Machine Learning Lab | 0 | 0 | 2 | 0 | 0 | 1 |
| PCR | | Software Engineering Lab | 0 | 0 | 2 | 0 | 0 | 1 |
| SEC | | Soft Skills & Inter-Personal Skills | 0 | 0 | 2 | 0 | 0 | 1 |
| INT | | Summer Internship - II | 0 | 0 | 0 | 0 | 0 | 1 |
| TOTAL | | | 28 | | | 25 | | |
| TOTAL (with Honours/Minor) | | | 31 | | | 28 | | |

| Semester VI | | | | | | | | |
|-----------------------------------|------|--|--------------|---|---|------------------|---|---|
| Category | Code | Course Title | WCH L-T-P | | | Credits L-T-P | | |
| THEORY | | | | | | | | |
| PCR | | Internet of Things | 3 | 0 | 0 | 3 | 0 | 0 |
| PCR | | Soft Computing | 3 | 0 | 0 | 3 | 0 | 0 |
| PCR | | Compiler Design | 3 | 0 | 0 | 3 | 0 | 0 |
| PEL | | Program Elective - IV | 3 | 0 | 0 | 3 | 0 | 0 |
| PEL | | Program Elective - V | 3 | 0 | 0 | 3 | 0 | 0 |
| PEL | | Program Elective - VI | 3 | 0 | 0 | 3 | 0 | 0 |
| HNS/MNR | | Honours / Minor - III | 3 | 1 | 0 | 3 | 1 | 0 |
| PRACTICAL | | | | | | | | |
| PCR | | Internet of Things Lab | 0 | 0 | 2 | 0 | 0 | 1 |
| PCR | | Soft Computing Lab | 0 | 0 | 2 | 0 | 0 | 1 |
| SEC | / | Emerging Technologies Lab / Entrepreneurship & Innovation | 0 | 0 | 4 | 0 | 0 | 2 |
| SEC | | Professional & Technical Writing | 0 | 0 | 2 | 0 | 0 | 1 |
| VAC | | Yoga / NSS / NCC | 0 | 0 | 2 | 0 | 0 | 0 |
| TOTAL | | | 30 | | | 23 | | |
| TOTAL (with Honours/Minor) | | | 37 | | | 27 | | |

4th Year B.Tech.(CSE)
(Without Practice School Option)

| Semester VII | | | | | | | | |
|-----------------------------------|------|-------------------------|--------------|---|---|------------------|---|---|
| Category | Code | Course Title | WCH L-T-P | | | Credits L-T-P | | |
| THEORY | | | | | | | | |
| OEL | | Open Elective - I | 3 | 0 | 0 | 3 | 0 | 0 |
| OOO | | MOOC - I | 0 | 0 | 0 | 3 | 0 | 0 |
| HNS/MNR | | Honours / Minor - IV | 3 | 1 | 0 | 3 | 1 | 0 |
| HNS/MNR | | Honours / Minor - V | 3 | 1 | 0 | 3 | 1 | 0 |
| PRACTICAL | | | | | | | | |
| PRJ | | Skill Lab & Project - I | 0 | 0 | 4 | 0 | 0 | 2 |
| INT | | Summer Internship - III | 0 | 0 | 0 | 0 | 0 | 1 |
| TOTAL | | | 7 | | | 9 | | |
| TOTAL (with Honours/Minor) | | | 15 | | | 17 | | |

| Semester VIII | | | | | | | | |
|------------------|------|---|--------------|---|----|------------------|---|---|
| Category | Code | Course Title | WCH L-T-P | | | Credits L-T-P | | |
| THEORY | | | | | | | | |
| OEL | | Open Elective - II | 3 | 0 | 0 | 3 | 0 | 0 |
| OOO | | MOOC - II | 0 | 0 | 0 | 3 | 0 | 0 |
| PRACTICAL | | | | | | | | |
| UCR | | Presentation Skills & Technical Seminar | 0 | 0 | 2 | 0 | 0 | 1 |
| PRJ | | Project - II | 0 | 0 | 16 | 0 | 0 | 8 |
| TOTAL | | | 21 | | | 15 | | |

| | | | | | | | | |
|---|--|--|------------|--|--|------------|--|--|
| GRAND TOTAL | | | 200 | | | 160 | | |
| GRAND TOTAL (with Honours/Minor) | | | 220 | | | 178 | | |

Note:

1. Courses offered under each elective are given in “List of Electives” on Page 10.
2. Courses for Honours and Minor are given in “List of Tracks for Honours and Minor” on Page 11.
3. MOOC - Massive Open Online Course (on NPTEL / Swayam / Other).
4. Approved list of courses for MOOC (self study) shall be published by the department. Students are advised to complete them before the end of 8th semester.
5. The Value Addition Course (Yoga / NSS / NCC) may be assigned in a different semester depending on available capacity.

4th Year B.Tech.(CSE)
(With Practice School Option in 7th Semester)

| Semester VII | | | | | | | | |
|------------------|------|---------------------------------------|--------------|---|---|------------------|---|----|
| Category | Code | Course Title | WCH L-T-P | | | Credits L-T-P | | |
| PRACTICAL | | | | | | | | |
| PSI | | Practice School / Industry Internship | 0 | 0 | 0 | 0 | 0 | 15 |
| INT | | Summer Internship - III | 0 | 0 | 0 | 0 | 0 | 1 |
| TOTAL | | | 0 | | | 16 | | |

| Semester VIII | | | | | | | | |
|-----------------------------------|------|-------------------------|--------------|---|---|------------------|---|---|
| Category | Code | Course Title | WCH L-T-P | | | Credits L-T-P | | |
| THEORY | | | | | | | | |
| OEL | | Open Elective - II | 3 | 0 | 0 | 3 | 0 | 0 |
| OOO | | MOOC - II | 0 | 0 | 0 | 3 | 0 | 0 |
| HNS/MNR | | Honours / Minor - IV | 3 | 1 | 0 | 3 | 1 | 0 |
| HNS/MNR | | Honours / Minor - V | 3 | 1 | 0 | 3 | 1 | 0 |
| PRACTICAL | | | | | | | | |
| PRJ | | Skill Lab & Project - I | 0 | 0 | 4 | 0 | 0 | 2 |
| TOTAL | | | 7 | | | 8 | | |
| TOTAL (with Honours/Minor) | | | 15 | | | 16 | | |

| | | | | | | | | |
|---|--|--|------------|--|--|------------|--|--|
| GRAND TOTAL | | | 179 | | | 160 | | |
| GRAND TOTAL (with Honours/Minor) | | | 197 | | | 178 | | |

Note:

1. Courses offered under each elective are given in “List of Electives” on Page 10.
2. Courses for Honours and Minor are given in “List of Tracks for Honours and Minor” on Page 11.
3. MOOC - Massive Open Online Course (on NPTEL / Swayam / Other).
4. Approved list of courses for MOOC (self study) shall be published by the department. Students are advised to complete them before the end of 8th semester.
5. The Value Addition Course (Yoga / NSS / NCC) may be assigned in a different semester depending on available capacity.

4th Year B.Tech.(CSE)
(With Practice School Option in 8th Semester)

| Semester VII | | | | | | | | |
|-----------------------------------|------|-------------------------|--------------|---|---|------------------|---|---|
| Category | Code | Course Title | WCH L-T-P | | | Credits L-T-P | | |
| THEORY | | | | | | | | |
| OEL | | Open Elective - I | 3 | 0 | 0 | 3 | 0 | 0 |
| OOO | | MOOC - I | 0 | 0 | 0 | 3 | 0 | 0 |
| HNS/MNR | | Honours / Minor - IV | 3 | 1 | 0 | 3 | 1 | 0 |
| HNS/MNR | | Honours / Minor - V | 3 | 1 | 0 | 3 | 1 | 0 |
| PRACTICAL | | | | | | | | |
| PRJ | | Skill Lab & Project - I | 0 | 0 | 4 | 0 | 0 | 2 |
| INT | | Summer Internship - III | 0 | 0 | 0 | 0 | 0 | 1 |
| TOTAL | | | 7 | | | 9 | | |
| TOTAL (with Honours/Minor) | | | 15 | | | 17 | | |

| Semester VIII | | | | | | | | |
|------------------|------|---------------------------------------|--------------|---|---|------------------|---|----|
| Category | Code | Course Title | WCH L-T-P | | | Credits L-T-P | | |
| PRACTICAL | | | | | | | | |
| PSI | | Practice School / Industry Internship | 0 | 0 | 0 | 0 | 0 | 15 |
| TOTAL | | | 0 | | | 15 | | |

| | | | | | | | | |
|---|--|--|------------|--|--|------------|--|--|
| GRAND TOTAL | | | 179 | | | 160 | | |
| GRAND TOTAL (with Honours/Minor) | | | 197 | | | 178 | | |

Note:

1. Courses offered under each elective are given in “List of Electives” on Page 10.
2. Courses for Honours and Minor are given in “List of Tracks for Honours and Minor” on Page 11.
3. MOOC - Massive Open Online Course (on NPTEL / Swayam / Other).
4. Approved list of courses for MOOC (self study) shall be published by the department. Students are advised to complete them before the end of 8th semester.
5. The Value Addition Course (Yoga / NSS / NCC) may be assigned in a different semester depending on available capacity.

List of Electives

| Code | Elective # and Subjects |
|---|---|
| <i>Program Elective - I</i> | |
| | Artificial Intelligence |
| | Computer Graphics |
| | Advanced Java Programming |
| <i>Program Elective - II</i> | |
| | Data Mining & Data Warehousing |
| | Cloud Computing |
| | System Programming |
| <i>Program Elective - III</i> | |
| | Big Data Analytics |
| | Realtime Systems |
| | Distributed Databases |
| <i>Program Elective - IV</i> | |
| | Natural Language Processing |
| | Wireless Sensor Networks |
| | Mobile Application Development |
| <i>Program Elective - V</i> | |
| | Data Visualization & Reporting |
| | Mobile Computing |
| | Cryptography & Network Security |
| <i>Program Elective - VI</i> | |
| | Bioinformatics Algorithms |
| | Embedded Systems |
| | Blockchain Technology |
| <i>Open Elective - I & II (Basket)</i> | |
| | Applied Linear Algebra |
| | Stochastic Processes |
| | Numerical Optimization |
| | Simulation & Modelling |
| | Fluid Mechanics |
| | Power Plant Engineering |
| | Project Management |
| | Organizational Behaviour |
| | Entrepreneurship Development |
| | Securities Analysis, Investment & Trading |
| | Circular Economy |

List of Tracks for Honours / Minor

| Code | Honours / Minor # and Subjects |
|--|---|
| <i>Honours in Computer Science & Engineering</i> | |
| | Stastical Inference |
| | Time Series Analysis |
| | Advanced Machine Learning |
| | Computer Vision |
| | Social Network Analysis |
| <i>Minor in “Smart Energy Systems”</i> | |
| | Circuit Theory |
| | Renewable Energy Systems |
| | Basics of Power Systems |
| | Smart Grid |
| | Electric & Hybrid Vehicles |
| <i>Minor in “VLSI System Design & Verification”</i> | |
| | Semiconductor Devices & Electronic Circuits |
| | Digital VLSI Design |
| | IC Fabrication Technology |
| | Digital IC Design & Verification |
| | Analog VLSI Design |
| <i>Minor in “Embedded & IoT System Design”</i> | |
| | Embedded C Applications |
| | Sensors & Transducers |
| | Embedded System Design |
| | Real Time Embedded Systems |
| | Industrial IoT |
| <i>Minor in “Business Management”</i> | |
| | Marketing Management |
| | Human Resources Management |
| | Production and Operation Management |
| | Financial Management |
| | Business & Corporate Law |

Note:

1. Choice for Honours or Minor must be submitted before the end of 3rd Semester.
2. A student can opt for either Honours or Minor, but not both.
3. Once opted for Honours or Minor, the same cannot be changed or converted.
4. Unless adequate number of students opt for Honours or Minor, it shall not be offered for the batch.

Part II

Detailed Syllabus

| Category | Code | ODE & Matrix Algebra | L-T-P | Credits | Marks |
|----------|--------|----------------------|-------|---------|-------|
| UCR | MT1001 | | 3-0-0 | 3 | 100 |

| | |
|------------------------|---|
| Objectives | The objective of this course is to study the concepts of solution of system of linear equations using matrix methods, Eigen values & Eigen vectors of matrices with application, ordinary differential equations with applications, and Laplace transform & its applications to ordinary differential and integral equations. |
| Pre-Requisites | Knowledge of elementary calculus, coordinate geometry of two & three dimensions and matrix algebra is required. |
| Teaching Scheme | Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities. |

Evaluation Scheme

| Attendance | Teacher's Assessment | Mid-Term | End-Term | Total |
|------------|----------------------|----------|----------|-------|
| 10 | 20 | 20 | 50 | 100 |

Detailed Syllabus

| Module-# | Topics | Hours |
|-----------------|---|-----------------|
| Module-1 | Matrix algebra, System of linear equations, Rank, Vector space, Existence and uniqueness of solution of a system of linear equations. | 8 Hours |
| Module-2 | Eigen values and Eigen vectors, Complex matrices, Diagonalization of matrices, Positive definite matrix, Singular Value Decomposition (SVD) and pseudo inverse. | 8 Hours |
| Module-3 | Separable ordinary differential equation and modeling, Exact ODE and Integrating factor, Linear ODE, Bernoulli's Equation, Modeling electrical circuits, Homogeneous linear ODE of second order, Second order Linear ODE with constant coefficients. | 8 Hours |
| Module-4 | Non-homogeneous linear ODE, Solution of Non-homogeneous linear ODE using undetermined coefficients, Euler-Cauchy ODE and applications to electrical circuits, Laplace transform, Inverse Laplace transform. | 8 Hours |
| Module-5 | Shifting theorems, Transform of derivatives and integrals, Unit step function and Dirac delta function, Applications to derivatives, Differentiation and integration of transforms, Convolution, Integral equation, Solution of system of differential equations. | 10 Hours |
| Total | | 42 Hours |

Text Books:

- T1. E. Kreyszig, *Advanced Engineering Mathematics*, 8th Ed., Wiley India, 2015.
- T2. G. Strang, *Linear Algebra and Its Applications*, 4th Ed., Cengage Learning, 2015.

Reference Books:

- R1. S. Pal and S. C. Bhunia, *Engineering Mathematics*, 1st Ed., Oxford University Press, 2015.
- R2. B. V. Ramana, *Higher Engineering Mathematics*, 1st Ed., McGraw Hill, 2017.

Online Resources:

1. <http://www.nptel.ac.in/courses/111105035>
2. <http://www.nptel.ac.in/courses/122104017>
3. <http://nptel.ac.in/courses/122102009>
4. <http://nptel.ac.in/courses/111107063>
5. <https://www.coursera.org/learn/linearalgebra2>

6. <https://www.coursera.org/learn/differentiation-calculus>
7. <https://www.coursera.org/learn/single-variable-calculus>
8. <https://alison.com/courses/Algebra-Functions-Expressions-and-Equations>

Course Outcomes: At the end of this course, the students will be able to:

| | |
|-----|--|
| CO1 | Solve a system of linear equations by applying the appropriate method. |
| CO2 | Apply Eigen values and Eigen vector techniques to find SVD and pseudo inverse of a matrix. |
| CO3 | Apply first order ordinary differential equations to solve real-world problems. |
| CO4 | Apply second order ordinary differential equations to solve problems of electrical circuits. |
| CO5 | Apply the concept of Laplace transforms to solve differential and integral equations. |

Program Outcomes Relevant to the Course:

| | |
|-----|--|
| 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). |

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

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

| Category | Code | Engineering Chemistry | L-T-P | Credits | Marks |
|----------|--------|-----------------------|-------|---------|-------|
| UCR | CH1001 | | 3-0-0 | 3 | 100 |

| | |
|------------------------|---|
| Objectives | The purpose of this course is to understand the fundamentals and applications of chemical sciences in the field of engineering. The course addresses the principles of general and engineering chemistry, so that the students can apply the knowledge in their areas of expertise. |
| Pre-Requisites | Preliminary knowledge of mole concept, oxidation and reduction, combustion, electromagnetic wave, and nano-materials is required. |
| Teaching Scheme | Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on examples and applications. |

Evaluation Scheme

| Attendance | Teacher's Assessment | Mid-Term | End-Term | Total |
|------------|----------------------|----------|----------|-------|
| 10 | 20 | 20 | 50 | 100 |

Detailed Syllabus

| Module-# | Topics | Hours |
|-----------------|--|-----------------|
| Module-1 | Water Treatments: Types of hardness-Units, Alkalinity of water and its significance, Softening methods and Numerical problems based on these methods, Membrane-based processes, Dissolved Oxygen, Problems with Boiler feed water and its treatments. | 9 Hours |
| Module-2 | Corrosion Science: Definition and scope of corrosion, Dry and wet corrosion, Direct chemical corrosion, Electro-chemical corrosion and its mechanisms, Types of electro-chemical corrosion (Differential aeration, Galvanic, Concentration cell), Typical Electro-chemical corrosion like Pitting, Soil, Waterline, Factors affecting corrosion, Protection from corrosion. | 8 Hours |
| Module-3 | Instrumental Techniques: Fundamentals of Spectroscopy, Principles and applications of molecular spectroscopy such as UV-visible, IR, Elementary idea about XRD, SEM & TEM. | 8 Hours |
| Module-4 | Energy Sciences: Types of fuels, Calorific value, Determination of calorific value, Combustion and its calculations, Solid fuel – Coal analysis (Proximate and ultimate analysis), Liquidfuels – Concept of knocking, Anti-knocking, Octane and Cetane Nos, Battery Technology — Fundamentals of primary & secondary cells, Rechargeable batteries – Lead acid storage battery, Lithium ion battery, Fuel cells – Principles, Applications, Solar PV Cells. | 9 Hours |
| Module-5 | Nanochemistry: Nanomaterials, Classification of nanomaterials, Synthesis and characterization of noble metal nanoparticles (Gold and oxide-based nanoparticles) using Green Synthetic route, Stabilization of nanoparticles using capping agents, Applications of nanomaterials, Carbon based nanomaterials and their applications, Brief on Graphene and Fullerene. | 8 Hours |
| Total | | 42 Hours |

Text Books:

- T1. Jain & Jain, *Engineering Chemistry*, 16th Ed., Dhanpat Rai Publishing Company, 2015.
- T2. Wiley-India Editorial Team, *Engineering Chemistry*, 2nd Ed., Wiley India, 2011.
- T3. C. N. Banwell, *Fundamentals of Molecular Spectroscopy*, 4th Ed., McGraw-Hill Education, 2017.

Reference Books:

- R1. S. S. Dara, *Engineering Chemistry*, 12th Ed., S. Chand Publisher, 2014.
- R2. G. A. Ozin & A. C. Arsenault, *Nanochemistry - A Chemical Approach to Nanomaterials*, 2nd Ed., RSC Publishing, 2008.
- R3. J. M. Lehn, L. Cademartiri, *Concepts of Nanochemistry*, 1st Ed., Wiley-VCH, 2009.
- R4. Y. R. Sharma, *Elementary Organic Spectroscopy*, S Chand & Co Ltd., 2013.

Online Resources:

1. <http://nptel.ac.in/courses/103105110/> - Fuel & Combustion
2. <http://nptel.ac.in/courses/105104102/hardness.htm>
3. http://nptel.ac.in/courses/105106112/1_introduction/5_corrosion.pdf
4. https://chem.libretexts.org/Core/Analytical_Chemistry/Electrochemistry/Exemplars/Corrosion/Corrosion_Basics
5. <https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/spectrpy/infrared/infrared.htm>
6. <https://alison.com> - Spectroscopic Technique, Colorimetry

Course Outcomes: At the end of this course, the students will be able to:

| | |
|-----|--|
| CO1 | Determine the hardness of water and apply difference processes to soften hard water. |
| CO2 | Utilize the knowledge of electro-chemistry and corrosion science for prevention of corrosion. |
| CO3 | Apply molecular spectroscopy to analyze organic compounds using spectrophotometer. |
| CO4 | Classify various fuels based on combustion parameters and understand the working principles of various batteries and solar photovoltaic cells. |
| CO5 | Explore synthesis & characterization of nanoparticles through green synthetic route. |

Program Outcomes Relevant to the Course:

| | |
|-----|--|
| 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 & Collaborative Team Work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams. |

Cont'd...

| | |
|------|---|
| 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) |
|------|---|

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 1 | 1 |
| CO2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | 1 | 1 | 2 | 1 |
| CO3 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | | | 1 | 1 | 2 | 1 |
| CO4 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | 1 | 1 | 1 | 1 |
| CO5 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | | | | 1 | 1 | 2 | 1 |

| Category | Code | Engineering Physics | L-T-P | Credits | Marks |
|----------|--------|---------------------|-------|---------|-------|
| UCR | PH1001 | | 3-0-0 | 3 | 100 |

| | |
|------------------------|--|
| Objectives | The objective of this course is to study various laws of physics and understand different phenomena using these principles. This knowledge is necessary for engineering students to understand the working of instruments and technologies, and also useful to prepare various engineering projects. |
| Pre-Requisites | Basic knowledge on waves, electrostatics, magnetism and mathematics is required. |
| Teaching Scheme | Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities. |

Evaluation Scheme

| Attendance | Teacher's Assessment | Mid-Term | End-Term | Total |
|------------|----------------------|----------|----------|-------|
| 10 | 20 | 20 | 50 | 100 |

Detailed Syllabus

| Module-# | Topics | Hours | |
|-----------------|---|----------------|-----------------|
| Module-1 | Wave Optics: Concept of wave and wave equation, Superposition of waves (two-beam and multiple beam), Huygen's principle, Interference, Theory of Newton's rings and its applications, Diffraction, Fresnel and Fraunhofer diffraction, Fraunhofer's diffraction from a single slit, Plane diffraction grating – theory and its applications. | 9 Hours | |
| Module-2 | Electromagnetic Waves: Gradient of scalar field, Divergence and curl of vector field, Gauss divergence theorem and Stoke's theorem (statement only), Gauss's law in electromagnetism, Faraday's law of electromagnetic induction, Ampere's circuital law, Displacement current, Maxwell's electromagnetic equations, Electromagnetic waves – Wave equations in free space, Dielectric and conducting medium, Poynting's theorem and Poynting's vector. | 9 Hours | |
| Module-3 | Quantum Mechanics: Introduction, Need of quantum mechanics, Particle nature of radiation - Black body radiation (no derivation), Photoelectric effect, Compton's effect and pair production, Concept of de-Broglie's matter waves, Heisenberg's uncertainty principle and its applications. | 8 Hours | |
| Module-4 | Schrödinger's Wave Equation & Applications: Concept of wave function ψ and interpretation of $ \psi ^2$, Schrödinger's time-dependent and time-independent wave equations, Expectation values, Operators in quantum mechanics, Eigenfunctions and Eigenvalues, Applications of Schrödinger's equation – Particle in a one dimensional box, Potential barrier. | 8 Hours | |
| Module-5 | Laser & Fiber Optics: Radiation-matter interaction, Absorption of light, Spontaneous and stimulated emission of light, Population inversion, Types of Laser – Solid State Laser (Ruby), Gas Laser (He-Ne), Properties and applications of Laser; Optical Fiber – Structure and Principle, Types of optical fiber, Numerical aperture, Applications of optical fiber. | 8 Hours | |
| Total | | | 42 Hours |

Text Books:

- T1. D. R. Joshi, *Engineering Physics*, 1st Ed., Tata McGraw-Hill Publication, 2017.
- T2. Md. M. Khan and S. Panigrahi, *Principle of Physics*, Vol. I & II, Cambridge Univ. Press.

P.T.O

Reference Books:

- R1. A. Ghatak, *Optics*, 7th Ed., McGraw-Hill Education, 2020.
 R2. D. J. Griffith, *Introduction to Electrodynamics*, 4th Ed., Pearson Education, 2015.
 R3. A. Beiser, *Concept of Modern Physics*, 6th Ed., McGraw-Hill Education, 2009.

Online Resources:

1. <https://nptel.ac.in/courses/115102026/>: by Prof. M. R. Shenoy, IIT Delhi
2. <https://nptel.ac.in/courses/113104012/>: by Prof. M. Katiyar and Prof. D. Gupta, IIT Kanpur
3. <https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2013/>
4. <http://www.ilectureonline.com/lectures/subject/PHYSICS>
5. <https://ocw.mit.edu/courses/physics>

Course Outcomes: *At the end of this course, the students will be able to:*

| | |
|-----|---|
| CO1 | Analyze wave properties of light like interference and diffraction and apply them in communications. |
| CO2 | Develop Maxwell's equations from basic laws of electromagnetism and apply them to understand the properties of electromagnetic waves. |
| CO3 | Analyze wave-particle duality to understand radiation-matter interaction. |
| CO4 | Develop and apply Schrödinger's equations to fields like bound particle, potential barrier etc. |
| CO5 | Investigate the basic principle, properties, operations and applications of laser & optical fiber in different fields like communication, industry, medicine, research etc. |

Program Outcomes Relevant to the Course:

| | |
|------|--|
| 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). |
| 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) |

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

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

| Category | Code | Basic Electronics Engineering | L-T-P | Credits | Marks |
|----------|--------|-------------------------------|-------|---------|-------|
| UCR | EC1001 | | 3-0-0 | 3 | 100 |

| | |
|------------------------|--|
| Objectives | The objectives of this course is to study the concepts and functionalities of electronic devices, tools and instruments, general specifications and deployability of the electronic devices, and assemblies in engineering applications. |
| Pre-Requisites | Knowledge of physics, chemistry, and introductory idea of semiconductors studied at the higher secondary level is required. |
| Teaching Scheme | Regular classroom lectures with use of ICT as and when required, and planned lectures to make the sessions interactive with problem solving activities. |

Evaluation Scheme

| Attendance | Teacher's Assessment | Mid-Term | End-Term | Total |
|------------|----------------------|----------|----------|-------|
| 10 | 20 | 20 | 50 | 100 |

Detailed Syllabus

| Module-# | Topics | Hours | |
|-----------------|--|----------------|-----------------|
| Module-1 | Semiconductor & Diodes: Types of semiconductors, Majority and minority charge carriers, Energy Band diagram, Transport phenomena, Law of Mass Action, Drift and Diffusion Current; Semiconductor Diode – Ideal vs. Practical, Diode equivalent circuits, Diode Applications – Rectifiers, Clipper, Clamper, and Switch, Zener Diode – Operation and Applications. | 9 Hours | |
| Module-2 | Transistors: Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying action, CB, CE, and CC configurations, Load line analysis, Fundamentals of biasing, Fixed biasing; Field Effect Transistor (FET) – Construction, Working principles, Characteristics of JFET & MOSFET. | 9 Hours | |
| Module-3 | Op-Amps, Oscillators, and Measuring Instruments: Introduction, Characteristics of ideal Op-Amp, Virtual Ground Concept, Pin Configuration, Applications of Op-Amp – Inverting & Non Inverting Amplifier, Summing Amplifier, Differentiator, Integrator; Oscillators – Barkhausen's Criteria, RC phase shift oscillator, Wien bridge oscillator; Measuring Instruments – Construction & working of CRO, DSO, and Multimeter. | 8 Hours | |
| Module-4 | Digital Logic: Number systems and its conversion, Signed & unsigned numbers, Binary arithmetic, 1's and 2's complement arithmetic, Basic & universal Logic gates, Boolean algebra and identities, Algebraic reduction using postulates of boolean algebra, Realization of boolean functions using universal logic gates. | 8 Hours | |
| Module-5 | Signals & Communication Systems: Signals – Continuous & Discrete-time, Analog & Digital, Energy & Power, Spectrum of a signal, Fourier Transform (Exponential, Sine and Cosine); Communication Systems – Block diagram, Modulation, Time & Frequency domain representation of AM, Carrier & side-band power calculation, Generation (Square law modulator), Demodulation (Synchronous demodulator). | 8 Hours | |
| Total | | | 42 Hours |

Text Books:

- T1. R. L. Boylestad and L. Nashelsky, *Electronic Devices and Circuit Theory*, 11th Ed., Pearson Education, 2015.

- T2. A. Agarwal and J. Lang, *Foundations of Analog and Digital Electronic Circuits*, 1st Ed., Morgan Kaufmann, 2005.
- T3. R. P. Singh and S. D. Sapre, *Communication Systems: Analog and Digital*, 3rd Ed., McGraw-Hill Education, 2014.

Reference Books:

- R1. A. S. Sedra and K. C. Smith, *Microelectronic Circuits*, 7th Ed., Oxford University Press, 2009.
- R2. V. K. Mehta and R. Mehta, *Principles of Electronics*, 10th Rev. Ed., S. Chand Publishing, 2006.
- R3. A. Kumar, *Fundamentals of Digital Circuits*, 3rd Ed., PHI Learning, 2014.

Online Resources:

1. <https://nptel.ac.in/courses/117103063/>: by Prof. G. Barua, IIT Guwahati
2. <https://nptel.ac.in/courses/108101091/>: By Prof. M. B. Patil, IIT Bombay
3. <https://nptel.ac.in/courses/122106025/>: By Prof. T. S. Natarajan, IIT Madras
4. <https://nptel.ac.in/courses/117107095/>: Web Content by IIT Roorkee
5. <https://nptel.ac.in/courses/122104013/>: Web Content by IIT Kanpur
6. <https://nptel.ac.in/courses/117106086/>: By Prof S.Srinivasan, IIT Madras
7. <https://nptel.ac.in/courses/117103064/>: By Prof A. Mahanta, IIT Guwahati

Course Outcomes: *At the end of this course, the students will be able to:*

| | |
|-----|--|
| CO1 | Understand basic principles of semiconductor diodes and their applications. |
| CO2 | Understand the construction, characteristics, configurations, and applications of transistors. |
| CO3 | Analyze the characteristics of Op-Amps & use them to design circuits for various applications. |
| CO4 | Convert numbers using different number systems and apply boolean algebra on them. |
| CO5 | Explain different types of signals and their characteristics using Fourier analysis tools. |

Program Outcomes Relevant to the Course:

| | |
|------|--|
| 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). |
| 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) |

P.T.O

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

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

| Category | Code | Basic Electrical Engineering | L-T-P | Credits | Marks |
|----------|--------|------------------------------|-------|---------|-------|
| UCR | EE1001 | | 3-0-0 | 3 | 100 |

| | |
|------------------------|--|
| Objectives | The objective of this course is to introduce the basic concepts of electricity and magnetism, DC & AC networks, principles of different electrical machines and measuring instruments, protection systems and safety requirements. |
| Pre-Requisites | Basic knowledge of intermediate physics and mathematics such as calculus, ordinary differential equations, matrices etc. is required. |
| Teaching Scheme | Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities. |

Evaluation Scheme

| Attendance | Teacher's Assessment | Mid-Term | End-Term | Total |
|------------|----------------------|----------|----------|-------|
| 10 | 20 | 20 | 50 | 100 |

Detailed Syllabus

| Module-# | Topics | Hours | |
|-----------------|--|-----------------|-----------------|
| Module-1 | Electric Circuits: Charge & current, Ideal & practical sources, Source conversion, Characteristics of circuit elements, Kirchhoff's current and voltage laws, Current & voltage division rule; Resistive Network Analysis – Node voltage & Mesh current (controlled & uncontrolled sources), Thevenin's theorem, Norton's theorem, Superposition theorem, Maximum power transfer theorem; Transient Analysis – Introduction, Differential equations, Time-domain analysis of first-order RL & RC circuits, Time constant. | 12 Hours | |
| Module-2 | Single-phase AC Circuit Analysis: Representation of sinusoidal waveforms, Peak and RMS values, Phasor representation, AC power analysis, Power factor, Improvement of power factor, Analysis of series & parallel AC circuits (R, L, C, RL, RC, RLC circuits), Series resonance, Q-factor. | 8 Hours | |
| Module-3 | Three-phase AC Circuit Analysis: Representation of 3-phase AC voltage, Phase sequence, Balanced load and source, Voltage and current relationship in star and delta connections, AC power analysis; Introduction to generation, transmission, and distribution of power system network, Residential wiring, Earthing, Electrical safety. | 7 Hours | |
| Module-4 | Electromagnetism: Magnetic flux, Reluctance, Series & parallel magnetic circuits, Magnetic materials, Hysteresis loop; Single-phase Transformer – Construction & working, Ideal and practical transformer, EMF equation, Equivalent circuit & phasor diagram of transformer on load and no-load, Shifting of impedances. | 8 Hours | |
| Module-5 | DC Machine: Construction, Working of generator and motor, EMF equation of generator, Back EMF of Motor, Classification based on excitation system; AC Machine: Construction and working of a 3-phase induction motor, Synchronous speed, Concept of slip, Construction, working, and types of single-phase induction motor. | 7 Hours | |
| Total | | | 42 Hours |

Text Books:

- T1. C. K. Alexander and M. N. O. Sadiku, *Fundamentals of Electric Circuits*, 6th Ed., McGraw-Hill, 2017.
- T2. E. Hughes, *Electrical & Electronic Technology*, 9th Ed., Pearson, 2004.
- T3. G. Rizzoni, *Principles and Applications of Electrical Engineering*, 5th Ed., McGraw Hill, 2006.

Reference Books:

- R1. A. E. Fitzgerald, D. E. Higginbotham, and A. Grabel, *Basic Electrical Engineering*, 5th Ed., Tata McGraw Hill.
- R2. B. L. Theraja and A. K. Theraja, *Textbook of Electrical Technology (Vol-I)*, 23rd Ed., S. Chand & Co.Ltd., 2002.
- R3. L. S. Bobrow, *Foundations of Electrical Engineering*, Asian Edition, Oxford Univ. Press, 2013.

Online Resources:

1. <https://nptel.ac.in/courses/108/105/108105053/>: by Prof. G. D. Roy, Prof. N. K. De, and Prof. T. K. Bhattacharya, IIT Kharagpur
2. <https://nptel.ac.in/courses/108/108/108108076/>: By Prof. L. Umanand, IISc Bangalore
3. <https://www.electrical4u.com/>

Course Outcomes: At the end of this course, the students will be able to:

| | |
|-----|---|
| CO1 | Understand and analyze basic electrical network with direct current source. |
| CO2 | Measure current, voltage, and power of series RLC circuit excited by single-phase AC circuit. |
| CO3 | Analyze 3-phase electrical systems and explore the engineering of practical power systems. |
| CO4 | Explain different concepts of magnetic fields and apply them to single-phase transformers. |
| CO5 | Describe the working principles of rotating electrical machines. |

Program Outcomes Relevant to the Course:

| | |
|-----|--|
| 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). |

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

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

| Category | Code | Engineering Mechanics | L-T-P | Credits | Marks |
|----------|--------|-----------------------|-------|---------|-------|
| UCR | ME1001 | | 2-0-0 | 2 | 100 |

| | |
|------------------------|--|
| Objectives | The objective of this course is to introduce engineering mechanics with the knowledge of statics, force equilibrium and free body diagrams, analysis of structures, beams and associated stresses along with elementary ideas on kinematics, dynamics, and mass moment of inertia. |
| Pre-Requisites | Knowledge of physics & mathematics and basic analytical skills is required. |
| Teaching Scheme | Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities. |

Evaluation Scheme

| Attendance | Teacher's Assessment | Mid-Term | End-Term | Total |
|------------|----------------------|----------|----------|-------|
| 10 | 20 | 20 | 50 | 100 |

Detailed Syllabus

| Module-# | Topics | Hours |
|-----------------|---|-----------------|
| Module-1 | Introduction: Basic concepts of vector analysis, Equilibrium of forces in two and three dimensions, Rectangular components of a force and its application, Varignon's theorem; Motion of a particle – Equation of motion, D'Alembert's principle, Planar cartesian & polar coordinates, Motion with constraints. | 8 Hours |
| Module-2 | Virtual Work and Energy: Virtual displacements, Principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom; Analysis of Structures: Trusses, Assumptions, Simple plane truss, Analysis by method of joints and method of sections. | 6 Hours |
| Module-3 | Center of Gravity & Moments of Inertia: Centroid and Centre of Gravity, Centroid of simple and composite sections, Theorems of Pappus and Guldinus, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Area moment of inertia of standard sections and composite sections, Mass moment inertia of circular plate, Cylinder, Cone, Sphere, parallelepiped. | 7 Hours |
| Module-4 | Stress & Strain: Normal stress, Shear stress, State of stress at a point, Ultimate strength, Allowable stress, Factor of safety; Relationship between elastic constants, Mechanical properties of materials, Stress-Strain behaviour; Flexural Loading – Shear force and bending moment in beams, Shear force and bending Moment Diagrams, Bending and shear stresses. | 7 Hours |
| Total | | 28 Hours |

Text Books:

- T1. M. K. Harbola, *Engineering Mechanics*, 2nd Ed., Cengage Learning, 2018.
- T2. G. H. Ryder, *Strength of Materials*, 3rd Ed., Macmillan Press, 1969.

Reference Books:

- R1. J. L. Meriam and L. G. Kraige, *Engineering Mechanics: Statics*, 8th Ed., Wiley India, 2014.
- R2. R. K. Rajput, *Strength of Materials: Mechanics of Solids*, 7th Ed., S. Chand Publications, 2018.
- R3. S. Timoshenko, D. H. Young, S. Pati, and J. V. Rao, *Engineering Mechanics*, 5th Ed., McGraw-Hill Education, 2013.

Online Resources:

1. <https://nptel.ac.in/courses/122104015/>: by Prof. M. Harbola, IIT Kanpur.
2. <https://nptel.ac.in/courses/105105108/>: by Prof. S. Bhattacharya, IIT Kharagpur)

Course Outcomes: At the end of this course, the students will be able to:

| | |
|-----|--|
| CO1 | Understand and analyze using the principles of mechanics to solve problems in statics. |
| CO2 | Articulate virtual work and investigate the nature of forces in the members of simple trusses. |
| CO3 | Explain area and mass moments of inertia and their application in structural design. |
| CO4 | Describe the mechanics of deformable bodies and mechanical properties of materials. |

Program Outcomes Relevant to the Course:

| | |
|------|--|
| 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). |
| 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) |

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 2 | 3 | 1 | 2 | 3 | 2 | | | | | 2 | 1 | 2 | 1 |
| CO2 | 3 | 2 | 1 | 2 | 3 | 1 | | | | | 2 | 1 | 2 | 1 |
| CO3 | 2 | 2 | 1 | 2 | 3 | 2 | | | | | 2 | 1 | 2 | 1 |
| CO4 | 2 | 2 | 1 | 2 | 3 | 2 | | | | | 2 | 1 | 2 | 1 |

| Category | Code | Engineering Thermodynamics | L-T-P | Credits | Marks |
|----------|--------|----------------------------|-------|---------|-------|
| UCR | ME1002 | | 2-0-0 | 2 | 100 |

| | |
|------------------------|--|
| Objectives | The objective of this course is to introduce laws of thermodynamics with emphasis on various equilibrium processes and their applications in practical domains like power plants, refrigerators and internal combustion engines. |
| Pre-Requisites | Knowledge of physics & mathematics and basic analytical skills is required. |
| Teaching Scheme | Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities. |

Evaluation Scheme

| Attendance | Teacher's Assessment | Mid-Term | End-Term | Total |
|------------|----------------------|----------|----------|-------|
| 10 | 20 | 20 | 50 | 100 |

Detailed Syllabus

| Module-# | Topics | Hours |
|-----------------|--|-----------------|
| Module-1 | Introduction, Basic concepts, System, Control volume, Surrounding, Boundaries, Universe, Types of systems, Macroscopic and microscopic viewpoints, Concept of continuum, Thermodynamic equilibrium, State, Property, Process, Exact & inexact differentials, Point & path functions, Cycle, Quasi-static process, Reversibility and irreversibility, Pressure measurement, Zeroth law of thermodynamics, Temperature, Principles of thermometry, Constant volume gas thermometer, Temperature scale. | 7 Hours |
| Module-2 | Pure Substances, p-v, T-v, T-s and h-s diagrams, Phase Transformations, Triple point and critical state, properties during change of phase, Dryness Fraction, Property tables. Brief discussion on the First law for cycle, closed system and open system (steady flow energy equation, SFEE), Perpetual Motion Machines, PMM1. | 7 Hours |
| Module-3 | Introduction to Second Law of Thermodynamics, Kelvin-Planck and Clausius' Statements and their Equivalence, Corollaries, PMM2, Carnot's Principle and Cycle, Entropy, Clausius' Inequality, Principle of Entropy and its application, T-s plot. | 7 Hours |
| Module-4 | Applications of Thermodynamics, Brief description and working principles of Steam Power Plant, Refrigerators and Heat pump, I.C. Engines (two-stroke and four-stroke, petrol and diesel) and Aircraft Propulsion Engines, Brayton Cycle, Rankine Cycle, Comparison. | 7 Hours |
| Total | | 28 Hours |

Text Books:

- T1. R. E. Sonntag and C. Borgnakke, *Fundamentals of Thermodynamics*, 7th Ed., John Wiley, 2014.
 T2. Y. A. Cengel and M. A. Boles, *Thermodynamics – An Engineering Approach*, 7th Ed., McGraw-Hill Education, 2011.

Reference Books:

- R1. P. K. Nag, *Engineering Thermodynamics*, 5th Ed., McGraw-Hill Education, 2013.
 R2. Y. V. C. Rao, *An Introduction to Thermodynamics*, 2nd Ed., University Press, 2004.

P.T.O

Online Resources:

1. <https://nptel.ac.in/courses/112105123/>: by Prof. S. Chakraborty, IIT Kharagpur
2. <https://www3.nd.edu/~powers/ame.20231/notes.pdf>
3. <https://ocw.mit.edu/courses/chemistry/5-60-thermodynamics-kinetics-spring-2008/>

Course Outcomes: *At the end of this course, the students will be able to:*

| | |
|-----|--|
| CO1 | Articulate the concepts of thermodynamic properties, equilibrium, temperature and pressure. |
| CO2 | Apply first laws of thermodynamics to analyze turbine, compressors, heat exchangers and nozzles by using steam table and ideal gas equation. |
| CO3 | Analyze the limitations of the First law and evaluate the available energy and irreversibility. |
| CO4 | Analyze power cycles and refrigeration cycles and their applications in the real world. |

Program Outcomes Relevant to the Course:

| | |
|------|--|
| 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). |
| 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) |

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3 | 2 | 2 | 1 | 2 | | | | | | 2 | 2 | 2 | 2 |
| CO2 | 3 | 3 | 2 | 2 | 1 | | | | | | 2 | 3 | 3 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 2 | | | | | | 3 | 2 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 2 | | | | | | 2 | 3 | 2 | 1 |

| Category | Code | Computer Programming | L-T-P | Credits | Marks |
|----------|--------|----------------------|-------|---------|-------|
| UCR | CS1001 | | 3-0-0 | 3 | 100 |

| | |
|------------------------|--|
| Objectives | The objective of this course is to introduce fundamentals of computer programming using the C programming language starting with simple programs to advanced topics like structures, pointers, file processing and pre-processor directives for solving various engineering problems through computer programming. |
| Pre-Requisites | Basic analytical and logical understanding including basic knowledge and usage of computers is required for this course. Prior experience with any other programming language will be beneficial. |
| Teaching Scheme | Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities. |

Evaluation Scheme

| Attendance | Teacher's Assessment | Mid-Term | End-Term | Total |
|------------|----------------------|----------|----------|-------|
| 10 | 20 | 20 | 50 | 100 |

Detailed Syllabus

| Module-# | Topics | Hours |
|-----------------|---|-----------------|
| Module-1 | Introduction to computers and programming, operating system, compilers, interpreters, algorithm, flowchart, pseudocode etc., structure of C program, character set, identifier, keywords, constants, variables, data types, operators, expressions, statements, operator precedence and associativity, type conversion, input/output statements. | 8 Hours |
| Module-2 | Decision making and branching: if, if-else, nested if-else, else-if ladder and switch constructs, iterative execution of code using loops: while, for, do-while, nested loops, controlling loop behavior using jump statements (break, continue, goto) and exit statements. | 8 Hours |
| Module-3 | Arrays (1-D & 2-D), declaration and initialization of arrays, accessing array elements, operations on arrays - insertion, deletion, searching, sorting (selection sort), merging etc., character arrays and strings, initialization, input & output of strings, operations on strings, array of strings, string handling functions. | 9 Hours |
| Module-4 | User-defined functions, declaration and definition, parameter passing by value, functions returning values, idea on call by reference, passing arrays to functions, recursion, storage classes - auto, register, static, extern, Structures and Unions - definition, initialization, accessing members, array of structures, arrays within structures, structures and functions, self-referential structures. | 9 Hours |
| Module-5 | Understanding pointers, declaration, initialization, accessing variables using pointers, pointer expressions, scale factor, chain of pointers, using pointers with arrays, strings, functions and structures, dynamic memory management, pre-processor directives, command line arguments, basics of file handling. | 8 Hours |
| Total | | 42 Hours |

Text Books:

- T1. E. Balagurusamy, *Programming in ANSI C*, 7th Ed., McGraw-Hill Education, 2017.
- T2. Y. Kanetker, *Let Us C*, 16th Ed., BPB Publications, 2018.

Reference Books:

- R1. B. W. Kernighan and D. M. Ritchie, *The C Programming Language*, 2nd Ed., Pearson Education, 2015.
- R2. H. Schildt, *C: The Complete Reference*, 4th Ed., McGraw-Hill, 2017.
- R3. A. Kelley and I. Pohl, *A Book on C*, 4th Ed., Pearson Education, 2008.
- R4. B. Gottfried, *Schaum's Outline of Programming with C*, 3rd Ed., McGraw-Hill, 2017.

Online Resources:

1. <https://nptel.ac.in/courses/106104128>: by Prof. S. Nandakumar, IIT Kanpur
2. <https://nptel.ac.in/courses/106105171>: Prof. A. Basu, IIT Kharagpur
3. <https://nptel.ac.in/courses/106106210>: by Prof. J. Viraraghavan, IIT Madras
4. <http://www.stat.cmu.edu/~hseltman/c/CTips.html>
5. <http://www.c-faq.com/>
6. <https://www.learn-c.org/>
7. <http://www2.its.strath.ac.uk/courses/c/>

Course Outcomes: At the end of this course, the students will be able to:

| | |
|-----|---|
| CO1 | Formulate logic of a problem and write C programs using variables, expressions and I/O. |
| CO2 | Develop structured C programs involving decision making using different control constructs. |
| CO3 | Solve problems involving similar set of data items and write C programs using arrays. |
| CO4 | Design modular C programs and handle heterogeneous data items using structures & unions. |
| CO5 | Develop complex C programs with file processing using advanced features of C programming. |

Program Outcomes Relevant to the Course:

| | |
|------|--|
| 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). |
| 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) |

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

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

| Category | Code | Constitution of India & Professional Ethics | L-T-P | Credits | Marks |
|----------|--------|---|-------|---------|-------|
| UMC | HS0001 | | | 3-0-0 | 0 |

| | |
|------------------------|--|
| Objectives | The objective of this mandatory course is to provide understanding of basic concepts of Indian Constitution and various organs created by the constitution including their functions. This course also introduces a holistic perspective towards life by understanding of the human reality and the rest of existence. |
| Pre-Requisites | Basic knowledge of Indian history, overall idea on India's political system, a positive bent of mind, zeal to know the essence of human existence and nature. |
| Teaching Scheme | Regular classroom lectures with use of ICT as and when required and each session is planned to be interactive. |

Evaluation Scheme

| Attendance | Teacher's Assessment | Mid-Term | End-Term | Total |
|------------|----------------------|----------|----------|-------|
| 10 | 20 | 20 | 50 | 100 |

Detailed Syllabus

| Module-# | Topics | Hours | |
|-----------------|---|----------------|-----------------|
| Module-1 | Introduction to Indian Constitution, Preamble, Salient Features, Fundamental Rights, Fundamental Duties, Features of Federal Structure, The Union Legislature – The Parliament, The Lok Sabha and Rajya Sabha, Composition, Powers and Functions. | 9 Hours | |
| Module-2 | Union Executive, President of India (with powers and functions), Vice-President, The Council of Ministers and the Prime Minister – Powers and Functions; State Government, The State Legislature – Composition, Powers and Functions, State Executive – Governor, Chief Minister, and State Council of Ministers. | 9 Hours | |
| Module-3 | Professional Ethics, Basic terms – Moral, Ethics, Ethical Dilemma, Emotional Intelligence, View on Ethics by Aristotle, Governing Factors of an Individual's Value System, Personal and Professional Ethics. | 7 Hours | |
| Module-4 | Profession, Professional, Professionalism, Professional Accountability, Professional Risks, Profession and Craftsmanship, Conflict of Interest, Ethics in Engineering – Purpose and Concept of Engineering Ethics, Engineering as Social Experimentation, Issues in Engineering Ethics, Engineers' Responsibility – Safety & Risk, Risk-Benefit Analysis, Causes of an Accident, Preventive Measures. | 9 Hours | |
| Module-5 | Value Education, Self-exploration as the Process for Value Education, Basic Human Aspirations – Continuous Happiness and Prosperity, Current Scenario, Method to Fulfill the Basic Human Aspirations, Harmony in the Human Being, Family, Society and Nature or Existence. | 8 Hours | |
| Total | | | 42 Hours |

Text Books:

- T1. D. D. Basu, *Introduction of Constitution of India*, 22nd Ed., LexisNexis, 2015.
- T2. R. Subramanian, *Professional Ethics*, 2nd Ed., Oxford University Press, 2017.
- T3. R. R. Gaur, R. Asthana, and G. P. Bagaria, *A Foundation Course in Human Values and Professional Ethics*, 2nd Ed., Excel Books, 2019..

Reference Books:

- R1. M. Laxmikanth, *Indian Polity*, 5th Ed., McGraw Hill, 2011.

- R2. K. Subas, *An Introduction to India's Constitution and Constitutional Law*, 5th Ed., National Book Trust India, 2011.
- R3. C. E. Harris, M. S. Pritchard, and M. J. Robins, *Engineering Ethics – Concepts and Cases*, 4th Ed., Cengage Learning, 2012.
- R4. A. N. Tripathi, *Human Values*, 3rd Ed., New Age International, 2019.

Online Resources:

1. <https://nptel.ac.in/courses/129106411>: by Prof. S. Bhat, IIT Madras
2. https://www.india.gov.in/sites/upload_files/npi/files/coi_part_full.pdf
3. <https://www.india.gov.in/my-government/constitution-india/constitution-india-full-text>

Course Outcomes: *At the end of this course, the students will be able to:*

| | |
|-----|--|
| CO1 | Describe basics of Indian constitution, fundamental laws and rights of Indian citizen. |
| CO2 | Articulate the union executive system and constitutional institutions of center and state. |
| CO3 | Understand basic purpose of profession, professional ethics and various moral and social issues. |
| CO4 | Realize the rights, responsibilities, and ethical principles of an Engineer at various levels. |
| CO5 | Understand importance of human values and live with harmony in family, society, and nature. |

Program Outcomes Relevant to the Course:

| | |
|------|--|
| 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 & 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) |

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

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

| Category | Code | Environmental Science & Engineering | L-T-P | Credits | Marks |
|----------|--------|-------------------------------------|-------|---------|-------|
| UMC | CH0001 | | 3-0-0 | 0 | 100 |

| | |
|------------------------|---|
| Objectives | The objective of this course is to introduce essential aspects of environmental science for engineering students. The course covers ecology, ecosystems, air and water pollution, management of municipal solid wastes, hazardous wastes and e-waste, along with environmental laws and UN conferences. |
| Pre-Requisites | Basic knowledge of physics, chemistry and biology is required for this course. |
| Teaching Scheme | Regular classroom lectures with use of ICT as and when required with focus on importance of environment, examples and case studies. |

Evaluation Scheme

| Attendance | Teacher's Assessment | Mid-Term | End-Term | Total |
|------------|----------------------|----------|----------|-------|
| 10 | 20 | 20 | 50 | 100 |

Detailed Syllabus

| Module-# | Topics | Hours | |
|-----------------|--|----------------|-----------------|
| Module-1 | Ecology, Ecosystems and Biogeochemical Cycles: Introduction to environmental science and engineering, Ecological perspective, Ecosystems and processes, Trophic pyramids, Biodiversity of species, Water, Oxygen, Nitrogen and Carbon cycle, Environmental gradient and tolerance levels of environmental factors. | 9 Hours | |
| Module-2 | Water and Wastewater Treatment: Water quality standards and parameters, water table, aquifer, pre-treatment, conventional treatment processes of water, DO, BOD, COD and microbial wastewater treatment. | 9 Hours | |
| Module-3 | Atmospheric Chemistry, Soil Chemistry and Noise Abatement: Atmospheric chemistry, air pollution and associated control equipment, climate change, soil chemistry, noise standards, noise measurement and noise abatement. | 8 Hours | |
| Module-4 | Waste Management: Types and management of MSW (Municipal Solid Waste), hazardous waste and e-waste, Introduction to LCA (Life Cycle Assessment). | 8 Hours | |
| Module-5 | EIA, EIS, Environmental Laws and Human Health: Environmental Audit, EIA (Environmental Impact Assessment), EIS (Environmental Impact Statement), Indian environmental laws, UN Conferences, Human population and the environment. | 8 Hours | |
| Total | | | 42 Hours |

Text Books:

- T1. G. M. Masters and W. P. Ela, *An Introduction to Environmental Engineering and Science*, 3rd Ed., PHI Learning, 2015.
- T2. G. Kiely, *Environmental Engineering*, Spl. Indian Edition, McGraw Hill, 2007.

Reference Books:

- R1. M. L. Davis and S. J. Masten, *Principles of Environmental Engineering and Science*, 2nd Ed., McGraw-Hill, 2017.
- R2. H. D. Kumar and U. N. Dash, *Environmental Studies*, 2nd Ed., IndiaTech Publishers, 2017.

Online Resources:

1. <http://nptel.ac.in/courses/120108002/>: Aquatic Biodiversity and Environmental Pollution.
2. <http://nptel.ac.in/courses/120108004/>: Environment Management.

3. <http://nptel.ac.in/courses/120108005/>: Municipal Solid Waste Management.
4. <https://www.epa.gov/environmental-topics/>: All Current Environmental Issues.

Course Outcomes: At the end of this course, the students will be able to:

| | |
|-----|--|
| CO1 | Describe the concepts of ecology, ecosystems, and biogeochemical cycles in the environment. |
| CO2 | Explain the process of water and wastewater treatment for prevention of water pollution. |
| CO3 | Understand the pollutants in the environment and explore the principles for their eradication. |
| CO4 | Explore waste minimization and management of different types of wastes generated. |
| CO5 | Understand EIA, EIS, and other environmental laws for prevention of pollution. |

Program Outcomes Relevant to the Course:

| | |
|------|--|
| 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 & Collaborative Team Work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams. |
| 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) |

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

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

| Category | Code | Probability & Statistics | L-T-P | Credits | Marks |
|----------|--------|--------------------------|-------|---------|-------|
| UCR | MT1002 | | 3-0-0 | 3 | 100 |

| | |
|------------------------|--|
| Objectives | The objective of this course is to familiarize the perspective engineers with the knowledge and concepts of probability and statistics which are essential to study non-deterministic systems. |
| Pre-Requisites | Basics of sets, counting techniques, differential and integral calculus of one variable and coordinate geometry of two and three dimensions. |
| Teaching Scheme | Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities. |

Evaluation Scheme

| Attendance | Teacher's Assessment | Mid-Term | End-Term | Total |
|------------|----------------------|----------|----------|-------|
| 10 | 20 | 20 | 50 | 100 |

Detailed Syllabus

| Module-# | Topics | Hours |
|-----------------|--|-----------------|
| Module-1 | Measures of central tendencies, Elementary probability, Conditional probability, Bayes' Rule (related problems only), Random variable, Binomial & Hypergeometric distribution, Mean and variance. | 8 Hours |
| Module-2 | The Poisson approximation to Binomial Distribution, Poisson Process, Geometric Distribution & Multinomial Distribution, Continuous random variables, Normal Distribution, Normal Approximation to the Binomial Distribution, Uniform Distribution, Exponential Distribution, Joint Discrete Distribution. | 9 Hours |
| Module-3 | Populations and Samples, Sampling Distribution of Mean (σ known), Sampling Distribution of Mean (σ unknown) & Sampling Distribution of Variance; Point Estimation of mean, Interval Estimation of mean, Tests of hypotheses and errors involved, Hypotheses concerning one mean, Inference concerning two mean, Estimation of variance, Hypotheses concerning one variance, Hypotheses concerning two variances. | 10 Hours |
| Module-4 | Estimation of Proportions, Hypotheses Concerning proportion (one & several), Analysis of $r \times c$ table (Contingency table), Goodness of fit. | 7 Hours |
| Module-5 | The method of least squares, Inferences based on the least square estimation, Curvilinear Regression, Checking the adequacy of the model, Correlation, Analysis of Variance, General principle, Completely Randomized Design, Randomized Block Design. | 8 Hours |
| Total | | 42 Hours |

Text Books:

- T1. R. A. Johnson, *Miller & Freund's - Probability and Statistics for Engineers*, 8th Ed., PHI Learning, 2011.

Reference Books:

- R1. W. Mendenhall, R. J. Beaver, and B. M. Beaver, *Probability and Statistics*, 14th Ed., Cengage Learning, 2014.
 R2. R. E. Walpole, R. H. Myers, S. L. Myers, and K. E. Ye, *Probability & Statistics for Engineers & Scientists*, 9th Ed., PHI Learning, 2012.

Online Resources:

1. <https://nptel.ac.in/courses/111/105/111105041/>: by Prof. S. Kumar, IIT Kharagpur
2. <https://ocw.mit.edu/courses/mathematics/18-440-probability-and-random-variables-spring-2014/lecture-notes/>

Course Outcomes: At the end of this course, the students will be able to:

| | |
|-----|---|
| CO1 | Apply the concepts of probability and random variables to evaluate probabilities of events. |
| CO2 | Apply different discrete and continuous probability models to solve real life problems. |
| CO3 | Apply the concepts of sampling to estimate population parameters and test hypothesis. |
| CO4 | Test the goodness of a model and apply it to real life problems. |
| CO5 | Apply regression model and ANOVA to study the characteristics of data sets. |

Program Outcomes Relevant to the Course:

| | |
|------|--|
| 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). |
| 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) |

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

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

| Category | Code | Data Structures & Algorithms | L-T-P | Credits | Marks |
|----------|--------|------------------------------|-------|---------|-------|
| UCR | CS1003 | | 3-0-0 | 3 | 100 |

| | |
|------------------------|---|
| Objectives | To understand the abstract data types and to solve problems using data structures such as stacks, queues, linked lists, hash tables, binary trees, heaps, binary search trees, graphs and writing programs for these solutions. |
| Pre-Requisites | Knowledge of programming in C, specifically on structures, pointers, functions, recursion etc., are required. |
| Teaching Scheme | Regular classroom lectures with use of ICT as and when required, sessions are planned to be interactive with focus on problem solving activities. |

Evaluation Scheme

| Attendance | Teacher's Assessment | Mid-Term | End-Term | Total |
|------------|----------------------|----------|----------|-------|
| 10 | 20 | 20 | 50 | 100 |

Detailed Syllabus

| Module-# | Topics | Hours |
|-----------------|--|-----------------|
| Module-1 | Introduction to data structures, classification of data structures, algorithmic notation, complexity of algorithms, asymptotic notations, abstract data types. Arrays - introduction, representation of arrays (row and column major representation), basic operations on array (traverse, insert, delete, search), sparse matrix, representation of sparse matrix using triplet form, operations on sparse matrix (addition, transpose) | 8 Hours |
| Module-2 | ADT Stack - stack model, representation of stack using array, basic operations with analysis, applications- recursion, and conversion of infix to post fix expression, evaluation of postfix expression. ADT Queue - queue model, representation using array, basic operations with analysis, circular queue, introduction to priority queue and double ended queue. | 8 Hours |
| Module-3 | Linked list - introduction, types of linked list (single, double, circular), representation in memory, operations on linked list (traverse, search, insert, delete, sort, merge) in each type with analysis. Representation of polynomial and its operations (addition, multiplication), implementation of stack and queue using linked list. | 9 Hours |
| Module-4 | Tree - terminology, representation, binary tree - tree traversal algorithms with and without recursion. Binary search tree, Operations on Binary Search Tree with analysis, threaded binary tree, general tree, Height balanced tree (AVL tree), m-way search trees, B-trees. Graph - terminology, representation (adjacency matrix, incidence matrix, path matrix, linked representation), graph traversal (BFS, DFS), Dijkstra's single source shortest path algorithm, Warshall's all pair shortest path algorithm, topological sort. | 9 Hours |
| Module-5 | Sorting algorithms - bubble sort, selection sort, insertion sort, quick sort, merge sort, radix sort, heap sort. Hashing- hash functions and hashing techniques. collision resolution techniques- linear probing, quadratic probing, chaining. | 8 Hours |
| Total | | 42 Hours |

Text Books:

- T1. M. A. Weiss, *Data Structures and Algorithm Analysis in C*, 2nd Ed., Pearson Education, 2002.
 T2. E. Horowitz, S. Sahni, S. A-Freed, *Fundamentals of Data Structures in C*, 2nd Ed., Univ. Press, 2008.

Reference Books:

- R1. A. M. Tenenbaum, Y. Langsam, and M. J. Augenstein, *Data Structures Using C*, 3rd Ed., Pearson Education, 2007.
- R2. J. P. Tremblay and P. G. Sorenson, *An Introduction to Data Structures with Applications*, 2nd Ed., McGraw Education, 2017.
- R3. S. Lipschutz, *Data Structures*, 1st Revised Ed., McGraw Education, 2014.

Online Resources:

1. <https://nptel.ac.in/courses/106/106/106106127/>: By Prof. H. A. Murthy, Prof. S. Balachandran, and Dr. N. S. Narayanaswamy, IIT Madras
2. <https://nptel.ac.in/courses/106/102/106102064/>: By Prof. N. Garg, IIT Delhi
3. <https://nptel.ac.in/courses/106/106/106106130/>: By Dr. N. S. Narayanaswamy, IIT Madras
4. <https://www.geeksforgeeks.org/data-structures/>

Course Outcomes: *At the end of this course, the students will be able to:*

| | |
|-----|---|
| CO1 | Analyze performance of algorithms and implement operations on arrays and sparse matrices. |
| CO2 | Apply the basic operations of stacks and queues to solve real world problems. |
| CO3 | Implement different types of linked list operations and their applications. |
| CO4 | Represent data using trees & graphs to use them in various real life applications. |
| CO5 | Analyze various sorting algorithms and explore different hashing techniques. |

Program Outcomes Relevant to the Course:

| | |
|------|--|
| 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). |
| 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) |

P.T.O

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

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

| Category | Code | Basic Electronics Engineering Lab | L-T-P | Credits | Marks |
|----------|--------|-----------------------------------|-------|---------|-------|
| UCR | EC1002 | | 0-0-2 | 1 | 100 |

| | |
|------------------------|---|
| Objectives | The objective of this practical course is to learn the concepts and functionalities of the electronic devices, tools and instruments. Students will understand general specifications and deployability of the electronic devices and assemblies, and also develop confidence in handling and usage of electronic devices, tools and instruments in engineering applications. |
| Pre-Requisites | Knowledge on intrinsic and extrinsic Semiconductors, Physics and Chemistry of Higher Secondary Science level. |
| Teaching Scheme | Regular laboratory experiments to be conducted under the supervision of teachers and demonstrators with the help of ICT, as and when required along with pre-lab session and demonstration for each experiment. |

Evaluation Scheme

| Attendance | Daily Performance | Lab Record | Lab Test / Mini Project | Viva-voce | Total |
|------------|-------------------|------------|-------------------------|-----------|-------|
| 10 | 30 | 15 | 30 | 15 | 100 |

Detailed Syllabus

| Experiment-# | Assignment/Experiment |
|--------------|---|
| 1 | Identification of electronic components and devices (Testing of semiconductor diodes and transistors using digital multi-meter). |
| 2 | Understand and use oscilloscope, signal generator to view waveforms and measure amplitude and frequency of a given waveform. |
| 3 | Generate V-I characteristics of semiconductor diode and determine its DC and AC resistances. |
| 4 | Implement clipper circuits (positive clipper and negative clippers) and observe its output waveforms and compare them with theoretically analyzed results. |
| 5 | Design half-wave and full-wave rectifier circuits without and with capacitor filter, record the waveforms and measure average & RMS values of the rectified output. |
| 6 | Generate and analyze the static characteristics of BJT in CE configuration. |
| 7 | Design the DC biasing (Fixed) circuit of transistor in CE configuration and determine its operating point. |
| 8 | Analyze the static characteristics of FET in CS configuration. |
| 9 | Apply Op-Amp in inverting, non-inverting, integrating and differentiating configurations & record their input-output waveforms. |
| 10 | Understand and verify truth tables of various logic gates. |
| 11 | Apply NAND and NOR as Universal logic gates. |
| 12 | Analyze and implement of R.C phase shift Oscillator using Op-AMP. |
| 13 | Design and simulate BJT and FET I/O characteristics using OrCAD PSpice/ Multisim. |
| 14 | Design and analysis of AM modulator and demodulator. |

Text Books:

- T1. R. L. Boylestad and L. Nashelsky, *Electronic Devices and Circuit Theory*, 11th Ed., Pearson Education.
- T2. A. S. Sedra and K. C. Smith, *Microelectronic Circuits*, 7th Ed., Oxford University Press.

Reference Books:

R1. V. K. Mehta and R. Mehta, *Principles of Electronics*, 3rd Ed., S. Chand Publishing, 1980.

Online Resources:

1. http://vlab.co.in/ba_labs_all.php?id=1
2. <http://iitg.vlab.co.in/?sub=59&brch=165>

Course Outcomes: At the end of this course, the students will be able to:

| | |
|-----|---|
| CO1 | Recognize electronic components, measuring instruments, semiconductor diodes and their use. |
| CO2 | Determine the characteristics of transistors and use them in various electronic circuits. |
| CO3 | Explore design and testing of Op-Amp and design circuits for various applications using them. |
| CO4 | Design and test digital circuits using logic gates for different applications. |

Program Outcomes Relevant to the Course:

| | |
|------|--|
| 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). |
| 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) |

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 2 | 2 | 1 | | | | | | | | | 1 | 1 | 1 |
| CO2 | 3 | 3 | 2 | 1 | | | | | | | | 2 | 2 | 2 |
| CO3 | 2 | 2 | 2 | 1 | | | | | | | | 2 | 2 | 2 |
| CO4 | 2 | 2 | 3 | | | | | | | | | 2 | 2 | 1 |

| Category | Code | Basic Electrical Engineering Lab | L-T-P | Credits | Marks |
|----------|--------|----------------------------------|-------|---------|-------|
| UCR | EE1002 | | 0-0-2 | 1 | 100 |

| | |
|------------------------|--|
| Objectives | The objective of this practical course is to expose the students to different electrical components and basic safety rules and regulations, give hands on practice about different measuring and protection equipment and their operations to understand and verify the concept of electrical & magnetic circuits and electric machines. |
| Pre-Requisites | Basic knowledge of different electrical components and different analysis techniques of electrical and magnetic circuits. Topics taught in Basic Electrical Engineering theory class are essential to conduct the experiments. |
| Teaching Scheme | Regular laboratory experiments conducted under supervision of the teacher. Demonstration will be given for each experiment. |

Evaluation Scheme

| Attendance | Daily Performance | Lab Record | Lab Test / Mini Project | Viva-voce | Total |
|------------|-------------------|------------|-------------------------|-----------|-------|
| 10 | 30 | 15 | 30 | 15 | 100 |

Detailed Syllabus

| Experiment-# | Assignment/Experiment |
|--------------|---|
| 1 | Measurement of power consumption & power factor of a fluorescent lamp and its power factor improvement. |
| 2 | Measurement of winding resistances of a DC compound machine. |
| 3 | Power & power factor measurement of three-phase load by two-wattmeter method. |
| 4 | Connection and testing of a single-phase energy meter. |
| 5 | Determination of open circuit characteristics (OCC) of a DC shunt generator. |
| 6 | Calculation of power & power factor in series R-L-C circuit excited by single-phase supply. |
| 7 | Determination of no-load parameters through OC Test of single-phase transformer. |
| 8 | Study of capacitor start and run single-phase induction motor/fan motor. |
| 9 | Study and verification of Thevenin's Theorem and Norton's Theorem. |
| 10 | Draw the B-H curve of a magnetic Specimen. |
| 11 | Starting of three-phase induction motor. |
| 12 | Voltage Regulation & efficiency of single-phase transformer by direct loading. |

Text Books:

- T1. A. Husain, *Fundamentals of Electrical Engineering*, 4th Ed., Dhanpat Rai & Co., 2016.
 T2. B. L. Thereja & A. K. Thereja, *A Textbook of Electrical Technology*, 23rd Ed., S. Chand & Co.

Reference Books:

- R1. J. B. Gupta, *A Textbook of Electrical Science*, S. K. Kataria & Sons, 2013.
 R2. B. R. Gupta and V. Singhal, *Electrical Science*, S. Chand & Co, 2005.

Online Resources:

- <https://nptel.ac.in/courses/108/105/108105053/>: by Prof. G. D. Roy, Prof. N. K. De, and Prof. T. K. Bhattacharya, IIT Kharagpur
- <https://nptel.ac.in/courses/108/108/108108076/>: By Prof. L. Umanand, IISc Bangalore
- <https://www.electrical4u.com/>
- www.electronics-tutorials.ws/dc-circuits

Course Outcomes: *At the end of this course, the students will be able to:*

| | |
|-----|---|
| CO1 | Get an exposure to common electrical components and their ratings. |
| CO2 | Develop electrical circuits and measure its characteristics using different measuring instruments and deploy different protective devices of appropriate ratings. |
| CO3 | Understand the usage of common electrical measuring instruments. |
| CO4 | Understand the basic characteristics of transformers and electrical machines. |
| CO5 | Verify different network theorems and magnetic properties. |

Program Outcomes Relevant to the Course:

| | |
|------|--|
| 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). |
| 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). |
| 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). |
| PO8 | Individual & 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) |

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

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

| Category | Code | Computer Programming Lab | L-T-P | Credits | Marks |
|----------|--------|--------------------------|-------|---------|-------|
| UCR | CS1002 | | 0-0-4 | 2 | 100 |

| | |
|------------------------|--|
| Objectives | To enable the students to analyze problems, formulate and implement solutions using the C programming language. The students will write C programs using proper logic to solve a problem and execute them on a computer. |
| Pre-Requisites | Basic analytical and logical understanding including basic knowledge and usage of computers is required for this course. |
| Teaching Scheme | Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments. |

Evaluation Scheme

| Attendance | Daily Performance | Lab Record | Lab Test / Mini Project | Viva-voce | Total |
|------------|-------------------|------------|-------------------------|-----------|-------|
| 10 | 30 | 15 | 30 | 15 | 100 |

Detailed Syllabus

| Experiment-# | Assignment/Experiment |
|--------------|---|
| 1 | Introduction to computers and Linux operating system. |
| 2, 3 | Get acquainted with the programming environment - Linux commands and VI-editor. |
| 4 | Editing, compiling, executing, and debugging of simple C programs. |
| 5 | Programs using operators and formatted input/output statements. |
| 6 | Decision making using if, if-else, else-if ladder, nested if. |
| 7 | Decision making using switch-case construct. |
| 8, 9 | Loop control structure (while, do-while, for) with jump statements. |
| 10 | Nested loops (printing various formats) |
| 11, 12 | 1-D arrays including operation like searching, sorting, merging etc. |
| 13 | Handling 2-D arrays such as matrix operations. |
| 14, 15 | Programs on strings using various string handling functions (library functions) |
| 16, 17 | Designing user-defined functions. |
| 18, 19 | Programs on recursion. |
| 20 | Designing user defined functions for string manipulation. |
| 21 | Passing arrays (both 1D and 2D) to functions. |
| 22, 23 | Structure, array of structure, nested structure. |
| 24 | Dynamic memory management. |
| 25 | Self-referential structure (create and display operation of single linked list) |
| 26, 27 | File handling - reading from and writing to files. |
| 28 | Command-line argument, pre-processor directives. |

Text Books:

- T1. E. Balagurusamy, *Programming in ANSI C*, 7th Ed., McGraw-Hill Education, 2017.
 T2. Y. Kanetker, *Let Us C*, 16th Ed., BPB Publications, 2018.

Reference Books:

- R1. B. W. Kernighan and D. M. Ritchie, *The C Programming Language*, 2nd Ed., Pearson Education, 2015.
 R2. H. Schildt, *C: The Complete Reference*, 4th Ed., McGraw-Hill, 2017.
 R3. A. Kelley and I. Pohl, *A Book on C*, 4th Ed., Pearson Education, 2008.

R4. B. Gottfried, *Schaum's Outline of Programming with C*, 3rd Ed., McGraw-Hill, 2017.

Online Resources:

1. <https://www.w3resource.com/c-programming-exercises/>
2. <https://www.includehelp.com/c-programming-examples-solved-c-programs.aspx>
3. https://www.onlinegdb.com/online_c_compiler
4. https://www.tutorialspoint.com/compile_c_online.php

Course Outcomes: *At the end of this course, the students will be able to:*

| | |
|-----|--|
| CO1 | Construct C programs for mathematical operations using control statements. |
| CO2 | Develop C programs for Array and String manipulation. |
| CO3 | Construct modular programs for better maintenance and reusability. |
| CO4 | Manipulate heterogeneous data using structure and union. |
| CO5 | Create and manipulate files using C programs. |

Program Outcomes Relevant to the Course:

| | |
|------|--|
| 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). |
| 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) |

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

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

| Category | Code | Communicative & Technical English | L-T-P | Credits | Marks |
|----------|--------|-----------------------------------|-------|---------|-------|
| SEC | HS1001 | | 0-0-4 | 2 | 100 |

| | |
|------------------------|---|
| Objectives | The objectives of this laboratory course are to provide practice sessions to enhance students' communication ability in the four language skills with focus on technical communication. |
| Pre-Requisites | Basic knowledge of general communication skills in english is required. |
| Teaching Scheme | Regular laboratory classes with various tasks designed to facilitate technical communication through pair and/or team activities with regular assessments, presentations, discussions, role-playing, audio-visual supplements, writing activities, business writing practices and vocabulary enhancement. |

Evaluation Scheme

| Attendance | Daily Performance | Lab Record | Lab Test / Mini Project | Viva-voce | Total |
|------------|-------------------|------------|-------------------------|-----------|-------|
| 10 | 30 | 15 | 30 | 15 | 100 |

Detailed Syllabus

| Experiment-# | Assignment/Experiment |
|--------------|--|
| 1 | Introduction to the course and diagnostic test. |
| 2 | JAM: content development, structuring and delivery. |
| 3 | Group presentation. |
| 4 | Effective Verbal Communication exercises: plain English, bias-free language, formal and informal style, usage etc. |
| 5 | Activities on non-verbal communication. |
| 6 | Sounds of English: Vowels and consonants. |
| 7 | Sounds of English: Transcription. |
| 8 | Sounds of English: Syllable and stress. |
| 9 | Sounds of English: Rhythm. |
| 10 | Sounds of English: Intonation I. |
| 11 | Sounds of English: Intonation II. |
| 12 | Role play on simulated business contexts considering different channels of business communication. |
| 13 | Listening comprehension. |
| 14 | Practice on elements of business writing. |
| 15 | Composing effective paragraphs with unity, coherence, cohesion, progression. |
| 16 | Process writing. |
| 17 | Writing memos. |
| 18 | Emails and email etiquette. |
| 19 | Business letter I. |
| 20 | Business letter II. |
| 21 | Error correction: usage and grammar. |
| 22 | Reading Comprehension I: Essay – skimming, scanning, inferential comprehension, critical reading. |
| 23 | Reading Comprehension II: Short story – Analysing the tone of the author. |

Cont'd...

| Experiment-# | Assignment/Experiment |
|--------------|---|
| 24 | Reading Comprehension III: News editorial – Differentiating facts from opinion. |
| 25 | Reading Comprehension IV: Texts on Science and Technology – Identifying discourse markers. |
| 26 | Reading Comprehension V: Texts on Science and Technology – Intensive reading and note-taking. |
| 27 | Note-making and summary writing. |
| 28 | Verbal Advantage: vocabulary exercises. |

Text Books:

- T1. M. A. Rizvi, *Effective Technical Communication*, 2nd Ed., Tata McGraw Hill, 2017.
 T2. M. Raman and S. Sharma, *Technical Communication: Principles and Practices*, 3rd Ed., Oxford University Press, 2015.
 T3. B. K. Das, K. Samantray, R. Nayak, S. Pani, and S. Mohaty, *An Introduction to Professional English & Soft Skills*, Cambridge Univ. Press, 2009.

Reference Books:

- R1. J. Seeley, *The Oxford Guide to Effective Writing and Speaking: How to Communicate Clearly*, 3rd Ed., Oxford University Press, 2013.
 R2. S. Kumar and P. Lata, *Communication Skills*, Oxford University Press, 2011.
 R3. T. Panigrahi, *Communicative Competence*, 1st Ed., Notion Press, 2024.

Online Resources:

- <https://nptel.ac.in/courses/109/106/109106094/>: by Prof. A. Iqbal, IIT Madras
- <https://nptel.ac.in/courses/109/104/109104031/>: by Dr. T. Ravichandran, IIT Kanpur
- <https://ocw.mit.edu/courses/comparative-media-studies-writing/21w-732-5-introduction-to-technical-communication-explorations-in-scientific-and-technical-writing-fall-2006/download-course-materials/>

Course Outcomes: *At the end of this course, the students will be able to:*

| | |
|-----|--|
| CO1 | Communicate with clarity, fluency and impact. |
| CO2 | Develop comprehensive understanding of communication concepts, its importance, types, barriers and principles. |
| CO3 | Communicate effectively in business set-ups. |
| CO4 | Compose coherent, clear and impactful business correspondences. |
| CO5 | Practice sub-skills of reading and become adept readers. |

Program Outcomes Relevant to the Course:

| | |
|-----|---|
| 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 & Collaborative Team Work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams. |

Cont'd...

| | |
|------|--|
| 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) |

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

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

| Category | Code | Workbench Practices | L-T-P | Credits | Marks |
|----------|--------|---------------------|-------|---------|-------|
| UCR | EE1003 | | 0-0-2 | 1 | 100 |

| | |
|------------------------|---|
| Objectives | The objective of this practical course is to provide hands-on exposure on tools, fasteners, computers, electrical wiring, electronic components & instruments, soldering & desoldering, making of PCB, and using other advanced tools necessary for creating working models and prototypes for engineers of circuit branches. |
| Pre-Requisites | Familiarity with some hand tools used in home is desired. |
| Teaching Scheme | Regular experiments and jobs using tools and instruments under supervision of the teacher. Demonstration will be given for each experiment. |

Evaluation Scheme

| Attendance | Daily Performance | Lab Record | Lab Test / Mini Project | Viva-voce | Total |
|------------|-------------------|------------|-------------------------|-----------|-------|
| 10 | 30 | 15 | 30 | 15 | 100 |

Detailed Syllabus

| Experiment-# | Assignment/Experiment |
|--------------|--|
| 1 | General introduction & familiarity with tools (measuring, marking, holding, and cutting tools), Fitting (Limit, Fit, Tolerance) and Fastening (different types of screws, rivets, nuts & bolts). |
| 2 | Disassembling and assembling of Desktop Computer System and recognize its parts. |
| 3 | Study of cables, wires, switches, fuses, MCB, and fuse carriers in an electrical network. |
| 4 | Study of earthing and electrical safety, demonstration of the precautionary steps in case of electrical shocks. |
| 5 | Calculation of current and power for series and parallel connected lamp load. |
| 6 | Study and design of house wiring. |
| 7 | Study of digital measuring equipment and calculation of energy consumption in an electrical system. |
| 8 | Study of basic electronic & electrical components (such as Resistor, Capacitor, Inductor, Potentiometer, Diode, Transistor, Sensors, ICs, etc.) for circuit design. |
| 9 | Study of PCB assembling tools (such as Soldering iron, De-soldering pump, Pliers, Cutters, Wire strippers, Crimping tool, Micro-soldering, Hot air soldering and de-soldering station etc.) |
| 10 | Study of different measuring and testing tools such as Multimeter, Digital Storage Oscilloscope (DSO), Clamp meter, and Function generator etc. |
| 11 | Familiarization with EDA tools (such as Eagle or Xcircuit) with general purpose components for designing PCB of simple circuits. |
| 12 | Fabrication & testing of single-sided and double-sided PCB for selected applications using general purpose instruments. |

Text Books:

- T1. B. H. Deshmukh, *Electrical Materials and Wiring Practices*, Nirali Prakashan, 2018.
- T2. G. Halder, *Electronics Course Book: Basic Components, IC boards, SMD, Logic Gates, Transistors, Resistors, Capacitors, Diodes, Audio Circuit and More*, GRPV Arts and Office Supplies, 2024.
- T3. R. S. Khandpur, *Printed Circuit Boards: Design, Fabrication, Assembly and Testing*, 1st Ed., McGraw Hill, 2006.

Reference Books:

- R1. H. Joshi, *Residential, Commercial and Industrial Electrical Systems: Protection, Testing and Commissioning, Vol-3*, McGraw-Hill Education, 2008.
- R2. S. Monk, *Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards*, 1st Ed., McGraw-Hill, 2014.
- R3. J. Varterisian, *Fabricating Printed Circuit Boards*, 1st Ed., Newnes, 2002.
- R4. A. Kemp, *The Makerspace Workbench: Tools, Technologies and Techniques for Making*, O'Reilly Media, 2013.

Online Resources:

1. https://bharatskills.gov.in/pdf/E_Books/Electrcian_SEM1_TP.pdf
2. https://bharatskills.gov.in/pdf/E_Books/Electrician_SEM2_TP.pdf
3. <https://bharatskills.gov.in/Home/StudyMaterial?var=WSdYV6aWadK8jUuNKxoBWg==>
4. https://onlinecourses.swayam2.ac.in/nou20_cs08/preview
5. https://www.lanl.gov/safety/electrical/docs/arc_flash_safety.pdf
6. https://www.ee.iitb.ac.in/~pcpandey/courses/ee616/pcblayout.c_aug07.pdf
7. <https://nptel.ac.in/courses/108/108/108108157/>
8. <https://nptel.ac.in/courses/122/106/122106025/>
9. <https://nptel.ac.in/courses/108/101/108101091/>

Course Outcomes: *At the end of this course, the students will be able to:*

| | |
|-----|--|
| CO1 | Utilize appropriate tools for various workbench jobs within their limits, fits, and tolerance. |
| CO2 | Disassemble and reassemble a computer System and replace its components. |
| CO3 | Identify and utilize common electrical components with proper safety mechanisms. |
| CO4 | Design house wiring and measure energy consumption using digital meters. |
| CO5 | Identify and use basic electronic components, PCB assembling, measuring and testing tools. |
| CO6 | Design and fabricate PCBs for different applications and assemble electronic components. |

Program Outcomes Relevant to the Course:

| | |
|-----|--|
| 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). |

Cont'd...

| | |
|------|--|
| PO7 | Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9) |
| PO8 | Individual & 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) |

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 1 | 1 | 1 | 1 | 1 | 1 | | | 1 | 1 | 1 | 1 | 1 | |
| CO2 | 1 | 1 | | | 3 | 1 | | 2 | | 1 | 2 | | | |
| CO3 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | | | |
| CO4 | 2 | 2 | 3 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | | | |
| CO5 | 2 | 2 | 1 | | 1 | | | 1 | | 1 | 1 | 2 | | |
| CO6 | 1 | 2 | 3 | | 3 | 1 | | 2 | | 1 | 1 | 1 | 2 | |

| Category | Code | Engineering Graphics | L-T-P | Credits | Marks |
|----------|--------|----------------------|-------|---------|-------|
| UCR | ME1003 | | 0-0-2 | 1 | 100 |

| | |
|------------------------|---|
| Objectives | The objective of this laboratory course is to learn engineering drawing standards, conventions & practices, develop drawing skills in 2D & 3D, and use computer-aided drawing software to create meaningful engineering drawings. |
| Pre-Requisites | Basic understanding of 2D and 3D geometry is required. |
| Teaching Scheme | Regular laboratory classes using drawing tools under supervision of the teacher. Demonstration will be given for each drawing assignment using both conventional and CAD software tools as per requirement. |

Evaluation Scheme

| Attendance | Daily Performance | Lab Record | Lab Test / Mini Project | Viva-voce | Total |
|------------|-------------------|------------|-------------------------|-----------|-------|
| 10 | 30 | 15 | 30 | 15 | 100 |

Detailed Syllabus

| Experiment-# | Assignment/Experiment |
|--------------|--|
| 1 | Principles of Engineering Graphics and their significance (lettering & scale) and usage of Drawing instruments. |
| 2 | Orthographic projections, Principles of orthographic projections, Projections of points and lines. |
| 3 | Projections of different planes. |
| 4 | Projection of solids, 3D to 2D views, Machine component diagrams, Sectional views of simple and compound solid models. |
| 5 | Principles of Isometric projection, Isometric Scale & Views, Isometric views of planes and solids. |
| 6 | Development of surface and intersection of surfaces. |
| 7 | Engineering curves and conics. |
| 8 | Introduction to AutoCAD, its GUI, toolbars and commands, shortcut keys. |
| 9 | 2D AutoCAD drawing using basic tools, Draw & Modify menu commands. |
| 10 | Orthographic projection drawings of various models using AutoCAD. |
| 11 | Isometric drawing & 3D modeling in AutoCAD, different solid editing options. |
| 12 | 3D modeling of simple & compound models, and machine components using AutoCAD. |

Text Books:

- T1. N. D. Bhat, M. Panchal, *Engineering Drawing*, Charotar Publishing House, 2008.
- T2. M. B. Shah, B. C. Rana, *Engineering Drawing and Computer Graphics*, Pearson Education, 2008.
- T3. S. Tickoo, *AutoCAD 2020 Work Book*, BPB Publications, 2020.

Reference Books:

- R1. R. K. Dhawan, *A Text Book of Engineering Drawing*, S. Chand Publications, 2007.
- R2. K. Venugopal, *Engineering Drawing and Graphics*, 3rd Ed., New Age International, 1998.

Online Resources:

1. <http://nptel.ac.in/courses/112103019>
2. <https://nptel.ac.in/courses/112/102/112102101/>
3. <https://freevideolectures.com/course/3420/engineering-drawing>

4. <https://www.autodesk.in/campaigns/autocad-tutorials>
5. <https://help.autodesk.com/view/ACD/2020/ENU/>

Course Outcomes: At the end of this course, the students will be able to:

| | |
|-----|---|
| CO1 | Understand and apply the concepts of lettering and dimensioning for drafting of machine drawings and building drawings and different conics and curves. |
| CO2 | Recognize and be familiar with the orthographic projections of points, lines, planes and solids. |
| CO3 | Visualize the real product from isometric projections, solid and sectional views. |
| CO4 | Draw 2D engineering drawings using various draw and modify tools of AutoCAD. |
| CO5 | Design various machine components and building structure by using AutoCAD. |

Program Outcomes Relevant to the Course:

| | |
|------|--|
| 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). |
| 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) |

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

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

| Category | Code | Data Structures & Algorithms Lab | L-T-P | Credits | Marks |
|----------|--------|----------------------------------|-------|---------|-------|
| UCR | CS1004 | | 0-0-4 | 2 | 100 |

| | |
|------------------------|--|
| Objectives | Develop skills to design and analyze simple linear and non linear data structures, strengthening the ability of students to identify and apply the suitable data structure for the given real world problem. |
| Pre-Requisites | Knowledge of programming in C, specifically on structures, pointers, functions, recursion etc., are required. |
| Teaching Scheme | Regular laboratory classes conducted under supervision of the teacher. The experiments shall comprise of programming assignments. |

Evaluation Scheme

| Attendance | Daily Performance | Lab Record | Lab Test / Mini Project | Viva-voce | Total |
|------------|-------------------|------------|-------------------------|-----------|-------|
| 10 | 30 | 15 | 30 | 15 | 100 |

Detailed Syllabus

| Experiment-# | Assignment/Experiment |
|--------------|---|
| 1 | Operations on arrays – insert, delete, merge. |
| 2 | Selection Sort, Bubble sort. |
| 3 | Linear Search and Binary search. |
| 4 | Representation of sparse matrix. |
| 5, 6 | Addition and transpose of sparse matrix. |
| 7 | Implementation of stack using array. |
| 8 | Conversion of infix to postfix expression. |
| 9 | Evaluation of postfix expression. |
| 10 | Operations of queue using array. |
| 11 | Operations of circular queue. |
| 12, 13 | Single linked list operations. |
| 14, 15 | Double linked list operations. |
| 16 | Circular linked list operations. |
| 17 | Stack using linked list. |
| 18 | Queue using linked list. |
| 19 | Polynomial addition using linked-list. |
| 20, 21 | Binary Search Tree operations. |
| 22, 23 | Graph traversal (BFS, DFS). |
| 24 | Warshall's shortest path algorithm. |
| 25, 26 | Implementation Insertion Sort and Quick Sort. |
| 27, 28 | Implementation of Merge Sort and Heap Sort. |

Text Books:

- T1. E. Horowitz, S. Sahni, S. Anderson-Freed, *Fundamentals of Data Structures in C*, 2nd Ed., Universities Press, 2008.
- T2. M. A. Weiss, *Data Structures and Algorithm Analysis in C*, 2nd Ed., Pearson Education, 2002.

Reference Books:

- R1. A. K. Rath and A. K. Jagadev, *Data Structures Using C*, 2nd Ed., Scitech Publication, 2011.

R2. Y. Kanetkar, *Data Structures Through C*, 2nd Ed., BPB Publication, 2003.

Online Resources:

1. <https://nptel.ac.in/courses/106/106/106106127/>: By Prof. H. A. Murthy, Prof. S. Balachandran, and Dr. N. S. Narayanaswamy, IIT Madras
2. <https://nptel.ac.in/courses/106/102/106102064/>: By Prof. N. Garg, IIT Delhi
3. <https://nptel.ac.in/courses/106/106/106106130/>: By Dr. N. S. Narayanaswamy, IIT Madras

Course Outcomes: At the end of this course, the students will be able to:

| | |
|-----|--|
| CO1 | Implement various operations on array and sparse matrix. |
| CO2 | Design functions to implement basic operations on stack & queue and apply them to solve real world problems. |
| CO3 | Implement single, double & circular linked list and apply them in various real life applications. |
| CO4 | Construct binary search tree and perform traversal, insertion, deletion, and search operations on it. |
| CO5 | Perform BFS and DFS traversal operations in a graph and implement various sorting and searching algorithms. |

Program Outcomes Relevant to the Course:

| | |
|------|--|
| 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). |
| 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) |

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

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

| Category | Code | Corporate Communication Skills | L-T-P | Credits | Marks |
|----------|--------|--------------------------------|-------|---------|-------|
| SEC | HS1002 | | 0-0-4 | 2 | 100 |

| | |
|------------------------|---|
| Objectives | The objective of this laboratory course is to give students adequate practice in a simulated professional environment with focus on communication skills with professionalism in a typical corporate set up. |
| Pre-Requisites | Knowledge of communicative and technical english is required. |
| Teaching Scheme | Regular laboratory classes with various tasks designed to facilitate communication and soft skills through pair and/or team activities with regular assessments, presentations, discussions, role-playing, audio-visual supplements, writing activities, business writing practices and vocabulary enhancement. |

Evaluation Scheme

| Attendance | Daily Performance | Lab Record | Lab Test / Mini Project | Viva-voce | Total |
|------------|-------------------|------------|-------------------------|-----------|-------|
| 10 | 30 | 15 | 30 | 15 | 100 |

Detailed Syllabus

| Experiment-# | Assignment/Experiment |
|--------------|---|
| 1 | Aspects of Inter-cultural communication and cultural conditioning. |
| 2 | Barriers to cross-cultural communication. |
| 3 | Personality test and personality development. |
| 4 | Team work and its stages. |
| 5 | Team work and leadership: Simulation. |
| 6 | Negotiation skills: Role-play. |
| 7 | Persuasive presentation I. |
| 8 | Persuasive presentation II. |
| 9 | Writing a blog. |
| 10 | Vlog making and presentation I. |
| 11 | Vlog making and presentation II. |
| 12 | Emotional Intelligence: its importance in the workplace. |
| 13 | Time management. |
| 14 | Social media etiquette. |
| 15 | Business etiquette. |
| 16 | Assertiveness at work: Role-play. |
| 17 | Power point presentation I. |
| 18 | Power point presentation II. |
| 19 | Power point presentation III. |
| 20 | Power point presentation IV. |
| 21 | Mind mapping. |
| 22 | Creative and critical thinking for problem solving. |
| 23 | Six thinking hats: Problem solving and decision making in meetings. |
| 24 | Verbal Ability I: synonyms and antonyms. |
| 25 | Verbal Ability II: One word substitution. |

Cont'd...

| Experiment-# | Assignment/Experiment |
|--------------|---------------------------------------|
| 26 | Verbal Ability III: Error correction. |
| 27 | Verbal Ability IV: Odd one out. |
| 28 | Verbal Ability V: Analogy. |

Text Books:

- T1. S. B. Bachu, *Corporate Communication Skills for Professionals*, 1st Ed., White Falcon Publishing, 2021.
- T2. M. A. Rizvi, *Effective Technical Communication*, 2nd Ed., Tata McGraw-Hill, 2017.
- T3. M. Raman and S. Sharma, *Technical Communication: Principles and Practice*, 3rd Ed., Oxford University Press, 2015.

Reference Books:

- R1. P. A. Argenti and J. Forman, *The Power of Corporate Communication: Crafting the Voice and Image of Your Business*, 1st Ed., Tata McGraw-Hill, 2003.
- R2. J. Seely, *The Oxford Guide to Writing and Speaking*, 3rd Ed., Oxford University Press, 2013.
- R3. B. K. Mitra, *Effective Technical Communication - A Guide for Scientists and Engineers*, 1st Ed., Oxford University Press, 2006.

Online Resources:

1. <https://archive.nptel.ac.in/courses/109/105/109105144/>: by Prof. S. Singh, IIT Kharagpur
2. <https://archive.nptel.ac.in/courses/109/106/109106129/>: by Dr. Ay. I. Viswamohan, IIT Madras
3. <https://archive.nptel.ac.in/courses/109/104/109104030/>: by Dr. T. Ravichandran, IIT Kanpur
4. <https://www.ef.com/wwen/english-resources/>
5. https://owl.purdue.edu/owl/purdue_owl.html
6. <https://www.usingenglish.com/>
7. <http://www.english-test.net>

Course Outcomes: *At the end of this course, the students will be able to:*

| | |
|-----|--|
| CO1 | Understand aspects of communication at the workplace and check the barriers. |
| CO2 | Hone persuasive communication skills. |
| CO3 | Enhance interpersonal communication at the corporate workplace. |
| CO4 | Make impactful group/solo presentations and communicate with clarity. |
| CO5 | Enhance verbal ability for better communication. |

Program Outcomes Relevant to the Course:

| | |
|-----|--|
| 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 & 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. |

Cont'd...

| | |
|------|---|
| 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) |

Mapping of COs to POs and PSOs (1: Low, 2: Medium, 3: High)

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



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