# MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE

## MADANAPALLE

## (UGC-AUTONOMOUS)

## www.mits.ac.in

## DEPARTMENT OF MECHANICAL ENGINEERING

## Course Structure

## &

## Detailed Syllabi

**For the students admitted to**

**B. Tech. Regular Four Year Degree Programme from the Academic Year 2023-24**

**and**

**B. Tech. Lateral Entry Scheme from the Academic Year 2024-25**

## DEPARTMENT OF MECHANICAL ENGINEERING

# Vision and Mission of the Institution

| | |
|---|---|
| **Vision** | To become a globally recognized research and academic institution and thereby contribute to technological and socio-economic development of the nation |
| **Mission** | To foster a culture of excellence in research, innovation, entrepreneurship, rational thinking and civility by providing necessary resources for generation, dissemination and utilization of knowledge and in the process create an ambience for practice-based learning to the youth for success in their careers. |

# Vision and Mission of the Department

| | |
|---|---|
| **Vision** | To be a Centre of Excellence in the field of Mechanical Engineering to generate quality human resource in mechanical engineering who can contribute constructively to the technological and socio-economic development of the Nation |
| **Mission** | ➢ To provide Globally competent Mechanical Engineers through Experienced and Committed Faculty."<br>➢ To nurture graduates with Scientific temperament, Rational thinking and Humanistic approach for Excelling in their Career."<br>➢ To promote Excellence in teaching and research through collaborative activities. |

## PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

**PEO1:** Build a successful career or pursue higher education in Mechanical Engineering and allied fields.

**PEO2:** Design, develop, maintain, and improve engineering systems and tools, while working in a team, for sustainable growth of the economy and continuous improvement in quality of human life.

**PEO3:** Engage in continuous learning to keep abreast with the latest technological developments in light of constantly changing environmental and social factors.

## PROGRAM OUTCOMES (POs)

At the end of the programme, graduate will be able to

**PO1: Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.

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

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

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

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

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

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

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

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

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

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

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

## PROGRAM SPECIFIC OUTCOMES (PSOs)

**PSO 1:** Apply concepts and principles from Applied Mechanics to design, develop, and evaluate mechanical systems for a specified purpose.

**PSO 2:** Employ governing laws of Thermodynamics, Fluid flow and Heat Transfer for design and analysis of thermo-fluid systems.

**PSO 3:** Utilize the knowledge and learning of materials and manufacturing sciences to design, plan and monitor production operations in an Industry.

# MADANAPALLE INSTITUTE OF TECHNOLOGY & SCIENCE, MADANAPALLE

## B. Tech Four Year Curriculum Structure

### Branch: MECHANICAL ENGINEERING

| | |
|---|---|
| **Total Credits** | 163 Credits for 2023(Regular) & 123 Credits 2024(Lateral Entry) Admitted Batch onwards |

### I. Induction Program and Holistic Development Activities

| Sl.No | Title | Duration |
|---|---|---|
| 1 | Induction Program<br>(Mandatory) | Three weeks' duration at the start of First Year |

# R23 - Curriculum Structure
## I Year I Semester

| S. No. | Category | Course Code | Course Title | Hours Per Week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Total | |
| 1 | HSMC | 23ENG101 | Communicative English | 2 | 0 | 0 | 2 | 2 |
| 2 | BSC | 23MAT101 | Linear Algebra and Calculus | 3 | 0 | 0 | 3 | 3 |
| 3 | BSC | 23CHE101 | Engineering Chemistry | 3 | 0 | 0 | 3 | 3 |
| 4 | ESC | 23CME101 | Basic Civil and Mechanical Engineering | 3 | 0 | 0 | 3 | 3 |
| 5 | ESC | 23CSE101 | Introduction to Programming | 3 | 0 | 0 | 3 | 3 |
| 6 | HSMC | 23ENG201 | Communicative English Laboratory | 0 | 0 | 2 | 2 | 1 |
| 7 | BSC | 23CHE201 | Engineering Chemistry Laboratory | 0 | 0 | 2 | 2 | 1 |
| 8 | ESC | 23CSE201 | Computer Programming Laboratory | 0 | 0 | 3 | 3 | 1.5 |
| 9 | ESC | 23ME201 | Engineering Workshop | 0 | 0 | 3 | 3 | 1.5 |
| 10 | HSMC | 23HUM201 | Health and Wellness, Yoga and Sports | - | - | 1 | 1 | 0.5 |
| **Total** | | | | **14** | **0** | **11** | **25** | **19.5** |

## I Year II Semester

| S. No. | Category | Course Code | Course Title | Hours Per Week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Total | |
| 1 | BSC | 23MAT102 | Differential Equations and Vector Calculus | 3 | 0 | 0 | 3 | 3 |
| 2 | BSC | 23PHY101 | Engineering Physics | 3 | 0 | 0 | 3 | 3 |
| 3 | ESC | 23EEE101 | Basic Electrical and Electronics Engineering | 3 | 0 | 0 | 3 | 3 |
| 4 | ESC | 23ME101 | Engineering Graphics | 1 | 0 | 4 | 5 | 3 |
| 5 | PCC | 23ME102 | Engineering Mechanics | 3 | 0 | 0 | 3 | 3 |
| 6 | BSC | 23PHY201 | Engineering Physics Laboratory | 0 | 0 | 2 | 2 | 1 |
| 7 | ESC | 23EEE201 | Electrical and Electronics Engineering Workshop | 0 | 0 | 3 | 3 | 1.5 |
| 8 | ESC | 23CSE202 | IT Workshop | 0 | 0 | 2 | 2 | 1 |
| 9 | PCC | 23ME202 | Engineering Mechanics Laboratory | 0 | 0 | 3 | 3 | 1.5 |
| 10 | HSMC | 23HUM202 | NSS / NCC / Scouts and Guides / Community Service | - | - | 1 | 1 | 0.5 |
| **Total** | | | | **13** | **0** | **15** | **28** | **20.5** |

(L = Lecture, T = Tutorial, P = Practical, C = Credit

# R23 - Curriculum Structure
## II Year I Semester

| S. No. | Category | Course Code | Course Title | Hours Per Week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Total | |
| 1 | HSMC | 23HUM101 | Universal Human Values | 2 | 1 | 0 | 3 | 3 |
| 2 | BSC | 23MAT105 | Numerical Methods | 3 | 0 | 0 | 3 | 3 |
| 3 | ESC | 23ME103 | Thermodynamics | 2 | 1 | 0 | 3 | 3 |
| 4 | PCC | 23ME104 | Mechanics of Solids | 2 | 1 | 0 | 3 | 3 |
| 5 | PCC | 23ME105 | Materials Science and Engineering | 3 | 0 | 0 | 3 | 3 |
| 6 | PCC | 23ME203 | Mechanics of Solids and Materials Science Laboratory | 0 | 0 | 3 | 3 | 1.5 |
| 7 | PCC | 23ME204 | Computer Aided Machine Drawing Laboratory | 0 | 0 | 3 | 3 | 1.5 |
| 8 | SEC | | **Skill Enhancement course – I** *(Refer ANNEXURE - VI)* | 1 | 0 | 2 | 3 | 2 |
| 9 | AUC | 23CHE901 | Environmental Science | 2 | 0 | 0 | 2 | - |
| **Total** | | | | **15** | **3** | **8** | **26** | **20** |

## II Year II Semester

| S. No. | Category | Course Code | Course Title | Hours Per Week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Total | |
| 1 | HSMC | 23HUM102 | Economics and Financial Accounting For Engineers | 2 | 0 | 0 | 2 | 2 |
| 2 | BSC | 23MAT103 | Probability and Statistics for Engineers | 3 | 0 | 0 | 3 | 3 |
| 3 | ESC | | **Design Thinking and Innovation Related Courses** *(Refer ANNEXURE - II)* | 1 | 0 | 2 | 3 | 2 |
| 4 | PCC | 23ME106 | Manufacturing Technology I | 3 | 0 | 0 | 3 | 3 |
| 5 | PCC | 23ME107 | Fluid Mechanics and Hydraulic Machines | 2 | 1 | 0 | 3 | 3 |
| 6 | PCC | 23ME108 | Theory of Machines | 2 | 1 | 0 | 3 | 3 |
| 7 | PCC | 23ME205 | Fluid Mechanics and Hydraulic Machines Laboratory | 0 | 0 | 3 | 3 | 1.5 |
| 8 | PCC | 23ME206 | Manufacturing Technology Laboratory | 0 | 0 | 3 | 3 | 1.5 |
| 9 | SEC | | **Skill Enhancement Course – II** *(Refer ANNEXURE - VI)* | 1 | 0 | 2 | 3 | 2 |
| **Total** | | | | **14** | **2** | **10** | **26** | **21** |

(L = Lecture, T = Tutorial, P = Practical, C = Credit

# R23 - Curriculum Structure
## III Year I Semester

| S. No. | Category | Course Code | Course Title | Hours Per Week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Total | |
| 1 | PCC | 23ME109 | Manufacturing Technology II | 3 | 0 | 0 | 3 | 3 |
| 2 | PCC | 23ME110 | Heat Transfer | 2 | 1 | 0 | 3 | 3 |
| 3 | PCC | 23ME111 | Metrology and Measurements | 3 | 0 | 0 | 3 | 3 |
| 4 | ESC | 23PHY102 | Introduction to Quantum Technologies and Applications | 3 | 0 | 0 | 3 | 3 |
| 5 | PE | | **Professional Elective - I** *(ANNEXURE - IV)* | 3 | 0 | 0 | 3 | 3 |
| 6 | OE | | **Open Elective - I** *(ANNEXURE - III)* | 3 | 0 | 0 | 3 | 3 |
| 7 | PCC | 23ME207 | Heat Transfer Laboratory | 0 | 0 | 3 | 3 | 1.5 |
| 8 | PCC | 23ME208 | Machine Tools and Metrology Laboratory | 0 | 0 | 3 | 3 | 1.5 |
| 9 | SEC | | **Skill Enhancement Course – III** *(Refer ANNEXURE - VI)* | 1 | 0 | 2 | 3 | 2 |
| 10 | ESC | 23ECE501 | Tinkering Laboratory | 0 | 0 | 2 | 2 | 1 |
| 11 | PROJ | 23ME701 | Summer Internship I | 0 | 0 | 4 | 4 | 2 |
| **Total** | | | | **18** | **1** | **14** | **33** | **26** |

## III Year II Semester

| S. No. | Category | Course Code | Course Title | Hours Per Week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Total | |
| 1 | PCC | 23ME112 | Thermal Engineering | 2 | 1 | 0 | 3 | 3 |
| 2 | PCC | 23ME113 | CAD/CAM | 3 | 0 | 0 | 3 | 3 |
| 3 | PCC | 23ME114 | Design of Machine Elements | 2 | 1 | 0 | 3 | 3 |
| 4 | PE | | **Professional Elective - II** *(ANNEXURE - IV)* | 3 | 0 | 0 | 3 | 3 |
| 5 | PE | | **Professional Elective-III** *(Annexure - IV)* | 3 | 0 | 0 | 3 | 3 |
| 6 | OE | | **Open Elective – II** *(ANNEXURE - III)* | 3 | 0 | 0 | 3 | 3 |
| 7 | PCC | 23ME209 | Thermal Engineering Laboratory | 0 | 0 | 3 | 3 | 1.5 |
| 8 | PCC | 23ME210 | CAD/CAM Laboratory | 0 | 0 | 3 | 3 | 1.5 |
| 9 | SEC | | **Skill Enhancement Course – IV** *(Refer ANNEXURE - VI)* | 1 | 0 | 2 | 3 | 2 |
| 10 | AUC | 23ENG901 | Technical Paper Writing and IPR | 2 | 0 | 0 | 2 | - |
| 11 | MC | 23ME901 | Workshop* | 0 | 0 | 0 | 0 | 0 |
| **Total** | | | | **19** | **2** | **8** | **29** | **23** |

(L = Lecture, T = Tutorial, P = Practical, C = Credit

*Domain specific workshop should be completed at the end of III Year I Semester

**Tentative Structure for Final Year:**

## R23 - Curriculum Structure
## IV Year I Semester

| S. No. | Category | Course Code | Course Title | Hours Per Week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Total | |
| 1 | PCC | 23ME115 | AI and ML for Mechanical Engineering | 3 | 0 | 0 | 3 | 3 |
| 2 | Management Course | | **Management Course- II** *(ANNEXURE – V)* | 2 | 0 | 0 | 2 | 2 |
| 3 | PE | | **Professional Elective – IV** *(ANNEXURE - IV)* | 3 | 0 | 0 | 3 | 3 |
| 4 | PE | | **Professional Elective – V** (*ANNEXURE - IV)* | 3 | 0 | 0 | 3 | 3 |
| 5 | OE | | **Open Elective – III** *(ANNEXURE - III)* | 3 | 0 | 0 | 3 | 3 |
| 6 | OE | | **Open Elective – IV** *(ANNEXURE - III)* | 3 | 0 | 0 | 3 | 3 |
| 7 | SEC | | **Skill Enhancement Course – V** *(Refer ANNEXURE - VI)* | 1 | 0 | 2 | 3 | 2 |
| 8 | AUC | 23HUM901 | Gender Sensitization | 2 | 0 | 0 | 2 | - |
| 9 | PROJ | 23ME702 | Summer Internship II | 0 | 0 | 4 | 4 | 2 |
| **Total** | | | | **20** | **0** | **6** | **26** | **21** |

## IV Year II Semester

| S. No. | Category | Course Code | Course Title | Hours Per Week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Total | |
| 1 | PROJ | 23ME703 | Project Work and Internship | 0 | 0 | 24 | 24 | 4 |
| **Total** | | | | **0** | **0** | **24** | **24** | **12** |

(L = Lecture, T = Tutorial, P = Practical, C = Credit

**ANNEXURE - I**

## THREE WEEK MANDATORY INDUCTION PROGRAMME

- Yoga and Meditation
- Sports and Games
- NSS
- NCC
- MITS Social Responsibility Club
- Management module
- Design Thinking
- Spoken and Written Communication

- ***Proficiency modules***

  - Basic Computer Proficiency
  - Interpersonal skills
  - Computer Graphics
  - Web programming
  - Mobile Apps
  - Vocabulary enhancement

## HOLISTIC DEVELOPMENT ACTIVITIES

**Description of Activities**

1. Physical and Health
2. Culture
3. Literature and Media
4. Social Service
5. Self-Development
6. Nature and Environment
7. Innovation

**ANNEXURE - II**

**DESIGN THINKING AND INNOVATION RELATED COURSES**
(To be offered under MOOC's Category from SWAYAM – NPTEL)

| Sl. No. | Course Code | Course Title |
|---|---|---|
| 1 | 23IIC5M01 | Design, Technology and Innovation |
| 2 | 23IIC5M02 | Introduction on Intellectual Property to Engineers and Technologists |
| 3 | 23IIC5M03 | Product Engineering and Design Thinking |
| 4 | 23IIC5M04 | Intellectual Property Rights and Competition Law |
| 5 | 23IIC5M05 | Innovation, Business Models and Entrepreneurship |
| 6 | 23IIC5M06 | Understanding Incubation and Entrepreneurship |
| 7 | 23IIC5M07 | Intellectual Property |
| 8 | 23IIC5M08 | Roadmap for Patent Creation |

Any new Innovation and Incubation Course offered by SWAYAM NPTEL can be appended in future.

**ANNEXURE – III**

**OPEN ELECTIVE – I**

(To be offered under Conventional Mode)

| Sl. No. | Course Code | Course Title | Course Offered by Department of |
|---|---|---|---|
| 1 | 23HUM301 | Indian Knowledge System | Humanities |
| 2 | 23MAT302 | Engineering Optimization | Mathematics |
| 3 | 23PHY301 | LASER Physics and Advanced LASER Technology | Physics |
| 4 | 23PHY302 | Thin Film Technology and its Applications | Physics |
| 5 | 23PHY303 | Waste To Sustainable Energy And Energy Systems | Physics |
| 6 | 23CHE301 | Chemistry of Polymers and its Applications | Chemistry |
| 7 | 23CHE302 | Green Chemistry and Catalysis for Sustainable Environment | Chemistry |
| 8 | 23CHE303 | Chemistry of Energy Systems | Chemistry |
| 9 | 23CE301 | Disaster Management | Civil |
| 10 | 23CE302 | Green Buildings | Civil |
| 11 | 23EEE301 | Electrical Safety Practices and Standards | EEE |
| 12 | 23EEE302 | Introduction to MEMS | EEE |
| 13 | 23ECE301 | Bio-Medical Electronics | ECE |
| 14 | 23ECE302 | VLSI Design | ECE |
| 15 | 23CSE301 | JAVA Programming | CSE |
| 16 | 23CST301 | Operating Systems | CST |
| 17 | 23CAI301 | Mobile Computing | CSE (AI) |
| 18 | 23CSD301 | Introduction to Data Science | CSE (DS) |
| 19 | 23CSM301 | AI for Everyone | CSE (AI and ML) |
| Any new Interdisciplinary Course can be appended in future. | | | |

**OPEN ELECTIVE – II**

(To be offered under MOOC's Category from SWAYAM – NPTEL)

| Sl. No. | Course Code | Course Title | Course Offered by Department of |
|---|---|---|---|
| 1 | 23HUM3M01 | English Language for Competitive Exams | Humanities and Social Sciences |
| 2 | 23HUM3M02 | Public Speaking | Humanities and Social Sciences |
| 3 | 23MG3M01 | E – Business | Management |
| 4 | 23MG3M02 | AI in Human Resource Management | Management |
| 5 | 23MG3M03 | AI in Marketing | Management |
| 6 | 23MG3M04 | Artificial Intelligence for Investments | Management |
| 7 | 23CE3M01 | Plastic Waste Management | Civil |
| 8 | 23CE3M02 | Safety in Construction | Civil |
| 9 | 23EEE3M01 | Transducers For Instrumentation | EEE |
| 10 | 23ECE3M01 | Microprocessors and Interfacing | ECE |
| 11 | 23ECE3M02 | Microprocessors and Microcontrollers | ECE |
| 12 | 23CSE3M01 | Privacy and Security in Online Social Media | CSE |
| 13 | 23CSE3M02 | Computer Networks and Internet Protocol | CSE |
| 14 | 23CSE3M03 | Introduction to Soft Computing | CSE |
| 15 | 23CSE3M04 | Human Computer Interaction (in Hindi) | CSE |
| 16 | 23MD3M01 | Research Methodology | Multidisciplinary |
| 17 | 23MD3M02 | Fuzzy Logic and Neural Networks | Multidisciplinary |

Any new Interdisciplinary Course offered by SWAYAM NPTEL can be appended in future.

**OPEN ELECTIVE – III**

(To be offered under MOOC's Category from SWAYAM – NPTEL)

| Sl. No. | Course Code | Course Title | Course Offered by Department of |
|---|---|---|---|
| 1 | 23MAT3M01 | Foundations of R Software | Mathematics |
| 2 | 23MAT3M02 | Foundations of R Software (in Hindi Language) | Mathematics |
| 3 | 23MGM05 | HR Analytics | Management |
| 4 | 23MG3M06 | Management Information System | Management |
| 5 | 23MG3M07 | Business Analytics & Text Mining Modeling using Python | Management |
| 6 | 23CE3M03 | Building Materials and Composites | Civil |
| 7 | 23EEE3M02 | Design of Photovoltaic Systems | EEE |
| 8 | 23ECE3M03 | System Design Through Verilog | ECE |
| 9 | 23CSE3M05 | Multi-Core Computer Architecture | CSE |
| 10 | 23CSE3M07 | Introduction to Internet of Things | CSE |
| 11 | 23CSE3M08 | Ethical Hacking | CSE |
| 12 | 23CSEM09 | Cyber Security and Privacy | CSE |
| 13 | 23MD3M03 | Learning Analytics Tools | Multidisciplinary |
| Any new Interdisciplinary Course offered by SWAYAM NPTEL can be appended in future. | | | |

**OPEN ELECTIVE – IV**

(To be offered under Conventional Mode)

| Sl. No. | Course Code | Course Title | Course Offered by Department of |
|---|---|---|---|
| 1 | 23CHE304 | Introduction to Nano Science and Technology | Chemistry |
| 2 | 23CHE305 | Water Pollution and its Management | Chemistry |
| 3 | 23CE303 | Environmental Impact Assessment | Civil |
| 4 | 23CE304 | Ground Improvement Techniques | Civil |
| 5 | 23CE305 | Sustainability in Engineering Practice | Civil |
| 6 | 23ECE303 | Embedded Systems | ECE |
| 7 | 20ECE304 | DSP Architecture | ECE |
| 8 | 20ECE305 | Community Radio Technology | ECE |
| 9 | 20CSE302 | Software Project Management | CSE |
| 10 | 23CSD302 | Cloud Computing | CSE (DS) |
| 11 | 23CSM302 | Chatbots and Virtual Assistants | CSE (AI and ML) |
| Any new Interdisciplinary Course can be appended in future. | | | |

**ANNEXURE - IV**

## LIST OF PROFESSIONAL ELECTIVES

| **Professional Elective – I**<br>(To be offered under MOOC's Category from SWAYAM – NPTEL) | | |
|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** |
| 1. | 23ME4M01 | Laser Based Manufacturing |
| 2. | 23ME4M02 | Rapid Manufacturing |
| 3. | 23ME4M03 | Operations Management |
| 4. | 23ME4M04 | Fundamental of Welding Science and Technology |
| 5. | 23ME4M05 | Introduction to Machining and Machining Fluids |
| Any other new Disciplinary Course which doesn't exist in the Curriculum can be appended in future. | | |

| **Professional Elective – II** | | |
|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** |
| 1. | 23ME401 | Refrigeration and Air Conditioning |
| 2. | 23ME402 | Renewable Energy Systems |
| 3. | 23ME403 | Non Destructive Testing |
| 4. | 23ME404 | Introduction to Composites |
| Any advanced courses can be appended in future. | | |

| **Professional Elective – III** | | |
|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** |
| 1. | 23ME405 | Operations Research |
| 2. | 23ME406 | Automation and Robotics |
| 3. | 23ME407 | Finite Element Methods |
| 4. | 23ME408 | Electric and Hybrid Vehicle Technology |
| Any advanced courses can be appended in future. | | |

| **Professional Elective – IV** | | |
|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** |
| 1. | 23ME409 | Computational Fluid Dynamics |
| 2. | 23ME410 | Fundamentals of Aerodynamics |
| 3. | 23ME411 | Product Lifecycle Management |
| 4. | 23ME412 | Industrial Internet of Things |
| Any advanced courses can be appended in future. | | |

| **Professional Elective –V** | | |
|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** |
| 1 | 23ME413 | Total Quality Management |
| 2 | 23ME414 | Cryogenics and Space Propulsion |
| 3 | 23ME415 | Waste to Energy Conversion Technologies |
| 4 | 23ME416 | Pneumatics and Hydraulics in Automation |
| Any advanced courses can be appended in future. | | |

**ANNEXURE – V**

| **MANAGEMENT COURSE – II** | | |
|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** |
| 1 | 23HUM103 | Business Ethics and Corporate Governance |
| 2 | 23HUM104 | Principles of Management |
| 3 | 23HUM105 | Human Resource Development |
| 4 | 23HUM106 | Management Science |
| 5 | 23HUM107 | National Cadet Corps |

**ANNEXURE - VI**

## List of Skill Oriented Courses

| **Skill Enhancement course – I** | | |
|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** |
| 1. | 23ENG601 | Soft Skills |
| Any Courses can be appended in future. | | |

| **Skill Enhancement course – II** | | |
|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** |
| 1. | 23CSE601 | Python Programming |
| Any Courses can be appended in future. | | |

| **Skill Enhancement course – III** | | |
|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** |
| 1. | 23ME601 | Machine Dynamics and Mechanical Vibrations |
| Any Courses can be appended in future. | | |

| **Skill Enhancement Course – IV** | | |
|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** |
| 1. | 23ME602 | Robotics and 3D Printing |
| Any Courses can be appended in future. | | |

| **Skill Enhancement Course – V** | | |
|---|---|---|
| **Sl. No.** | **Course Code** | **Course Title** |
| 1. | 23ME603 | Drone Technology |
| Any Courses can be appended in future. | | |

**ANNEXURE – VII**

## Minors in Mechanical Engineering

## (Applicable to CE, EEE, CSE, CST, CSE (AI), CSE (DS), CSE (CS), CSE (AI and ML) and CSE (Networks))

**Stream Name: Thermal Engineering**

| Sl. No | Category | Course Code | Course Title | Hours Per Week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Total Contact Hours | |
| **III Year I Semester** | | | | | | | | |
| 1 | Professional Core Course | 23MDME101 | Fluid Mechanics and Hydraulic Machinery | 2 | 1 | 0 | 3 | 3 |
| 2 | Professional Core Course | 23MDME102 | Applied Thermodynamics | 2 | 1 | 0 | 3 | 3 |
| 3 | Professional Core Course | 23MDME201 | Fluid Mechanics and Hydraulic Machinery Laboratory | 0 | 0 | 3 | 3 | 1.5 |
| **III Year II Semester** | | | | | | | | |
| 4 | Professional Core Course | 23MDME103 | Heat Transfer | 2 | 1 | 0 | 3 | 3 |
| 5 | Professional Core Course | 23MDME104 | Computational Fluid Dynamics | 2 | 1 | 0 | 3 | 3 |
| 6 | Professional Core Course | 23MDME202 | Thermal Engineering Laboratory | 0 | 0 | 3 | 3 | 1.5 |
| **IV Year I Semester** | | | | | | | | |
| 7 | Professional Core Course | 23MDME105 | Design of Gas Turbine Engines | 2 | 1 | 0 | 3 | 3 |
| | | | **Total** | **10** | **5** | **6** | **21** | **18** |

## Minor in Quantum Computing

## (Applicable to CE, EEE, ME, ECE, CSE, CST, CSE (AI), CSE (DS), CSE (CS), CSE (AI and ML) and CSE (Networks))

**Stream Name: Quantum Computing**

| Sl. No | Category | Course Code | Course Title | Hours Per Week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Total Contact Hours | |
| **III Year I Semester** | | | | | | | | |
| 1 | Professional Core Course | 23MDINS101 | Introduction to Quantum Computing | 3 | 0 | 0 | 3 | 3 |
| 2 | Professional Core Course | 23MDINS102 | Mathematical Foundations for Quantum Computing | 3 | 0 | 0 | 3 | 3 |
| 3 | Professional Core Course | 23MDINS201 | Quantum Programming and Simulation Laboratory | 0 | 0 | 3 | 3 | 1.5 |
| **III Year II Semester** | | | | | | | | |
| 4 | Professional Core Course | 23MDINS103 | Quantum Algorithms | 3 | 0 | 0 | 3 | 3 |
| 5 | Professional Core Course | 23MDINS104 | Quantum Information and Communication | 3 | 0 | 0 | 3 | 3 |
| 6 | Professional Core Course | 23MDINS202 | Quantum Algorithms Laboratory | 0 | 0 | 3 | 3 | 1.5 |
| **IV Year I Semester** | | | | | | | | |
| 7 | Professional Core Course | 23MDINS105 | Quantum Machine Learning (QML) | 3 | 0 | 0 | 3 | 3 |
| | | | **Total** | **15** | **0** | **6** | **21** | **18** |

## Minor in Quantum Technologies

## (Applicable to CE, EEE, ME, ECE, CSE, CST, CSE (AI), CSE (DS), CSE (CS), CSE (AI and ML) and CSE (Networks))

**Stream Name: Quantum Technologies**

| Sl. No | Category | Course Code | Course Title | Hours Per Week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Total Contact Hours | |
| **III Year I Semester** | | | | | | | | |
| 1 | Professional Core Course | 23MDINS106 | Foundations of Quantum Technologies | 3 | 0 | 0 | 3 | 3 |
| 2 | Professional Core Course | 23MDINS107 | Solid State Physics for Quantum Technologies | 3 | 0 | 0 | 3 | 3 |
| 3 | Professional Core Course | 23MDINS203 | Quantum Devices and Materials Laboratory | 0 | 0 | 3 | 3 | 1.5 |
| **III Year II Semester** | | | | | | | | |
| 4 | Professional Core Course | 23MDINS108 | Introduction to Quantum Communication | 3 | 0 | 0 | 3 | 3 |
| 5 | Professional Core Course | 23MDINS109 | Introduction to Quantum Sensing | 3 | 0 | 0 | 3 | 3 |
| 6 | Professional Core Course | 23MDINS204 | Quantum Communication and Sensing Laboratory | 0 | 0 | 3 | 3 | 1.5 |
| **IV Year I Semester** | | | | | | | | |
| 7 | Professional Core Course | 23MDINS110 | Quantum Optics Prerequisites for Quantum Technologies | 3 | 0 | 0 | 3 | 3 |
| | | | **Total** | **15** | **0** | **6** | **21** | **18** |

**ANNEXURE - VIII**

## Honors in Mechanical Engineering

| Sl.No | Category | Course Code | Course Title | Hours Per Week | | | | Credits |
|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | Total Contact Hours | |
| **III Year I Semester** | | | | | | | | |
| 1 | Professional Core Course | 23HDME101 | Advanced Welding Technology | 3 | 0 | 0 | 3 | 3 |
| 2 | Professional Core Course | 23HDME102 | Product Design Development | 3 | 0 | 0 | 3 | 3 |
| 3 | Professional Core Course | 23HDME201 | Advanced Welding Laboratory | 0 | 0 | 3 | 3 | 1.5 |
| **III Year II Semester** | | | | | | | | |
| 4 | Professional Core Course | 23HDME103 | Refrigeration System Design | 3 | 0 | 0 | 3 | 3 |
| 5 | Professional Core Course | 23HDME104 | Industrial Tribology and Surface Engineering | 3 | 0 | 0 | 3 | 3 |
| 6 | Professional Core Course | 23HDME202 | Advanced Manufacturing Technology Laboratory | 0 | 0 | 3 | 3 | 1.5 |
| **IV Year I Semester** | | | | | | | | |
| 7 | Professional Core Course | 23HDME105 | Rocket and Space Propulsion | 3 | 0 | 0 | 3 | 3 |
| | | | **Total** | **15** | **0** | **6** | **21** | **18** |

# I Year I Semester

**B. Tech I Year I Semester**

## 23ENG101 COMMUNICATIVE ENGLISH

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 0 | 2 |

**Pre-requisite:** None

**Course Objectives:**

The main objective of introducing this course, Communicative English, is to facilitate effective listening, Reading, Speaking and Writing skills among the students. It enhances the same in their comprehending abilities, oral presentations, reporting useful information and providing knowledge of grammatical structures and vocabulary. This course helps the students to make them effective in speaking and writing skills and to make them industry ready.

**UNIT I Lesson: HUMAN VALUES: Gift of Magi (Short Story) 6 hours**

**Listening:** Identifying the topic, the context and specific pieces of information by listeningto short audio texts and answering a series of questions.
**Speaking:** Asking and answering general questions on familiar topics such as home,family, work, studies and interests; introducing oneself and others.
**Reading:** Skimming to get the main idea of a text; scanning to look for specific pieces ofinformation.
**Writing:** Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences.
**Grammar:** Parts of Speech, Basic Sentence Structures-forming questions
**Vocabulary:** Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words.

**UNIT II Lesson: NATURE: The Brook by Alfred Tennyson (Poem) 6 hours**

**Listening:** Answering a series of questions about main ideas and supporting ideas afterlistening to audio texts.
**Speaking:** Discussion in pairs/small groups on specific topics followed by short structuretalks.
**Reading:** Identifying sequence of ideas; recognizing verbal techniques that help to linkthe ideas in a paragraph together.
**Writing:** Structure of a paragraph - Paragraph writing (specific topics)
**Grammar:** Cohesive devices - linkers, use of articles and zero article; prepositions.
**Vocabulary:** Homonyms, Homophones, Homographs.

**UNIT III Lesson: BIOGRAPHY: Elon Musk 6 hours**

**Listening:** Listening for global comprehension and summarizing what is listened to.
**Speaking:** Discussing specific topics in pairs or small groups and reporting what

isdiscussed
**Reading:** Readinga text in detail by making basic inferences -recognizing and interpretingspecific context clues; strategies to use text clues for comprehension.
**Writing:** Summarizing, Note-making, paraphrasing
**Grammar:** Verbs - tenses; subject-verb agreement; Compound words, Collocations
**Vocabulary:** Compound words, Collocations

**UNIT IV** **Lesson: INSPIRATION: The Toys of Peace by Saki** **6 hours**

**Listening:** Making predictions while listening to conversations/ transactional dialogues without video; listening with video.

**Speaking:** Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.

**Reading:** Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data.

**Writing:** Letter Writing: Official Letters, Resumes

**Grammar:** Reporting verbs, Direct & Indirect speech, Active & Passive Voice

**Vocabulary:** Words often confused, Jargons

**UNIT V** **Lesson: MOTIVATION: The Power of Intrapersonal Communication (An Essay)** **6 hours**

**Listening:** Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.

**Speaking:** Formal oral presentations on topics from academic contexts

**Reading:** Reading comprehension.

**Writing:** Writing structured essays on specific topics.

**Grammar:** Editing short texts –identifying and correcting common errors in grammar andusage (articles, prepositions, tenses, subject verb agreement)

**Vocabulary:** Technical Jargons

**Course Outcomes:**

**CO1:** Understand the topic, context, and pieces of specific information from personal , professional and social situations

**CO2:** Apply discourse markers to speak clearly in formal discussions

**CO3:** Analyze and apply grammatical structures to formulate contextualized phrases and sentences

**CO4:** Analyze texts and images to write summaries based on global comprehension

**CO5:** Draft coherent paragraphs and structured essays

**Text Books:**

1. Pathfinder: Communicative English for Undergraduate Students, 1st Edition, Orient Black Swan, 2023 (Units 1,2 & 3)
2. Empowering with Language by Cengage Publications, 2023 (Units 4 & 5)

**Reference Books:**

1. Dubey, Sham Ji & Co. English for Engineers, Vikas Publishers, 2020
2. Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge, 2014.
3. Murphy, Raymond. English Grammar in Use, Fourth Edition, Cambridge University Press, 2019.
4. Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary. Anchor, 2014.

**Web Resources**

**Grammer**

1. www.bbc.co.uk/learningenglish
2. https://dictionary.cambridge.org/grammar/british-grammar/
3. www.eslpod.com/index.html
4. https://www.learngrammar.net/
5. https://english4today.com/english-grammar-online-with-quizzes/

**VOCABULARY**

1. https://www.youtube.com/c/DailyVideoVocabulary/videos
2. https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**B. Tech I Year I Semester**

## 23MAT101 LINEAR ALGEBRA AND CALCULUS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Objectives:**

To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real-world problems and their applications.

**UNIT I MATRICES** **9 hours**

Rank of a matrix by echelon form, normal form. Cauchy–Binet formulae (without proof). Inverse of non-singular matrices by Gauss-Jordan method, System of linear equations: Solving system of Homogeneous and Non-Homogeneous equations by Gauss elimination method, Jacobi and Gauss Seidel Iteration Methods.

**UNIT II EIGENVALUES, EIGENVECTORS AND ORTHOGONAL TRANSFORMATION** **9 hours**

Eigenvalues, Eigenvectors and their properties, Diagonalization of a matrix, Cayley-Hamilton Theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton Theorem,Quadratic forms and Nature of the Quadratic Forms, Reduction of Quadratic form to canonicalforms by Orthogonal Transformation.

**UNIT III CALCULUS** **9 hours**

Mean Value Theorems: Rolle's Theorem, Lagrange's mean value theorem with their geometrical interpretation, Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof), Problems and applications on the above theorems.

**UNIT IV PARTIAL DIFFERENTIATION AND APPLICATIONS (MULTI VARIABLE CALCULUS)** **9 hours**

Functions of several variables: Continuity and Differentiability, Partial derivatives, total derivatives, chain rule, Taylor's and Maclaurin's series expansion of functions of two variables. Jacobians, Functional dependence, maxima and minima of functionsof two variables, method of Lagrange multipliers.

**UNIT V MULTIPLE INTEGRALS (MULTI VARIABLE CALCULUS)** **9 hours**

Double integrals, triple integrals, change of order of integration, change of variables to polar, cylindrical and spherical coordinates. Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

**Course Outcomes:**

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

CO1: Solve the system of linear equations and apply the matrix algebra techniques in practical applications.

CO2: Utilize the Eigenvalues, Eigenvectors and applications of diagonalization in the field of Science and Technology.

CO3: Relate the results of mean value theorems in real life problems.

CO4: Apply the functions of several variables to evaluate the rates of change with respect to time and space variables in engineering.

CO5: Compute the area and volume by interlinking them to appropriate double and triple integrals.

**Text Books:**

**1.** Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition

**2.** Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10th Edition.

**Reference Books:**

**1.** Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018, $14^{th}$ Edition.
**2.** Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, AlphaScience International Ltd., 2021 $5^{th}$ Edition(9th reprint).
**3.** Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, $5^{th}$Edition.
**4.** Advanced Engineering Mathematics, Micheael Greenberg, Pearson publishers, $9^{th}$edition
**5.** Higher Engineering Mathematics, H. K Das, Er. Rajnish Verma, S. Chand Publications, 2014, Third Edition (Reprint 2021)

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**B. Tech I Year I Semester**

## 23CHE101 ENGINEERING CHEMISTRY

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Objectives:**

- To familiarize engineering chemistry and its applications
- To impart the concept of soft and hard waters, softening methods of hard water
- To train the students on the principles and applications of electrochemistry, polymers, surface chemistry, and cement

### UNIT I WATER TECHNOLOGY 9 hours

Soft and hardwater, Estimation of hardness of water by EDTA Method, Estimation of dissolved Oxygen - Boiler troubles –Priming, foaming, scale and sludge, Caustic embrittlement, Industrial water treatment – Ion-exchange processes - desalination of brackish water, reverse osmosis (RO), electrodialysis and Specifications for drinking water as per BIS and WHO standards.

### UNIT II ELECTROCHEMISTRY AND APPLICATIONS 9 hours

Electrodes –electrochemical cell, Nernst equation, cell potential calculations.
Primary cells – Zinc-air battery, Sodium-air battery, Secondary cells – Nickel-Cadmium (NiCad),and lithium-ion batteries- working principle of the batteries including cell reactions; Fuel Cells-Basic Concepts, the principle and working of hydrogen-oxygen Fuel cell.
Corrosion: Introduction to corrosion, electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion, metal oxide formation by dry electrochemical corrosion, Pilling Bedworth ratios and uses, Factors affecting the corrosion, cathodic and anodic protection, electroplating and electro less plating (Nickel and Copper).

### UNIT III POLYMERS AND FUEL CHEMISTRY 9 hours

Introduction to polymers, functionality of monomers, Mechanism of chain growth, step growth polymerization, Poly Dispersity Index (PDI) & it's significance.
Thermoplastics and Thermo-setting plastics-: Preparation, properties and applications of poly styrene. PVC, Nylon 6,6 and Bakelite.
Elastomers – Preparation, properties and applications of Buna S, Buna N, Thiokol rubbers.
Fuels – Types of fuels, calorific value of fuels, numerical problems based on calorific value; Analysis of coal (Proximate and Ultimate analysis), Liquid Fuels, refining of petroleum, Octane and Cetane number- alternative fuels- propane, methanol, ethanol and bio fuel-bio diesel.

### UNIT IV MODERN ENGINEERING MATERIALS 9 hours

Composites- Definition, Constituents, Classification- Particle, Fibre and Structural reinforced composites, properties and Engineering applications
Refractories- Classification, Properties, Factors affecting the refractory materials and Applications.
Lubricants- Classification, Functions of lubricants, Mechanism, Properties of lubricating oils – Viscosity, Viscosity Index, Flash point, Fire point, Cloud point, saponification and Applications.
Building materials- Portland Cement, constituents, Setting and Hardening of cement (with chemical reactions).

**UNIT V SURFACE CHEMISTRY AND NANOMATERIALS 9 hours**

Introduction to surface chemistry, colloids, nanometals and nanometal oxides, micelle formation, synthesis of colloids (Braggs Method), chemical and biological methods of preparation of nanometals and metal oxides, stabilization of colloids and nanomaterials by stabilizing agents,

Adsorption isotherm (Freundlich and Langmuir), BET equation (no derivation) applications of colloids and nanomaterials – catalysis, medicine, sensors, etc.

**Course Outcomes:**

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

CO1: Explain the estimation of impurities present in water like hardness and softening of impure water.

CO2: Explain the working principles of batteries & demonstrate the corrosion prevention methods and factors affecting corrosion

CO3: Explain the preparation, properties, and applications of thermoplastics, thermosetting, elastomers & conducting polymers & explain calorific values, octane number, refining of petroleum and cracking of oils.

CO4: Explain the setting and hardening of cement, properties of composites, lubricants & refractories.

CO5: Summarize the concepts of colloids, micelle and nanomaterials.

**Text Books:**

**1.** Jain and Jain, Engineering Chemistry, 16/e, DhanpatRai, 2013.

**2.** Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e,Oxford University Press, 2010.

**3.** G V Subba Reddy, K N Jayaveera, C Ramachandraiah, Engineering Chemistry, McGraw-Hill; First Edition, 2019.

**Reference Books:**

**1.** H.F.W. Taylor, Cement Chemistry, 2/e, Thomas Telford Publications, 1997.

**2.** D.J. Shaw, Introduction to Colloids and Surface Chemistry, Butterworth-Heineman, 1992.

**3.** Textbook of Polymer Science, Fred W. Billmayer Jr, 3rd Edition

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**B. Tech I Year I Semester**

## 23CME101 BASIC CIVIL AND MECHANICAL ENGINEERING

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Objectives:**

- Get familiarized with the scope and importance of Civil Engineering sub-divisions.
- Introduce the preliminary concepts of surveying.
- Acquire preliminary knowledge on Transportation and its importance in nation's economy.
- Get familiarized with the importance of quality, conveyance and storage of water.
- Introduction to basic civil engineering materials and construction techniques.

### PART A: BASIC CIVIL ENGINEERING

### UNIT I BASICS OF CIVIL ENGINEERING 8 hours

Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geo-technical Engineering- Transportation Engineering - Hydraulics and Water Resources Engineering - Environmental Engineering-Scope of each discipline - Building Construction and Planning- Construction Materials-Cement - Aggregate - Bricks- Cement concrete- Steel. Introduction to Prefabricated construction Techniques.

### UNIT II SURVEYING 8 hours

Objectives of Surveying- Horizontal Measurements- Angular Measurements- Introduction to Bearings Levelling instruments used for levelling -Simple problems on levelling and bearings-Contour mapping.

### UNIT III TRANSPORTATION ENGINEERING 8 hours

Importance of Transportation in Nation's economic development- Types of Highway Pavements- Flexible Pavements and Rigid Pavements - Simple Differences. Basics of Harbour, Tunnel, Airport, and Railway Engineering.

Water Resources and Environmental Engineering: Introduction, Sources of water- Quality of water- Specifications- Introduction to Hydrology–Rainwater Harvesting-Water Storage and Conveyance Structures (Simple introduction to Dams and Reservoirs).

**Course Outcomes:**

CO1: Identify various sub-divisions of Civil Engineering and to appreciate their role in ensuring better society.

CO2: Measure of distances, angles and levels through surveying.

CO3: Identify various transportation infrastructures, sources of water and various water conveyance, storage structures like dams and reservoirs.

**Text Books:**

**1.** Basic Civil Engineering, M.S.Palanisamy, , Tata Mcgraw Hill publications (India) Pvt.Ltd. Fourth Edition.

**2.** Introduction to Civil Engineering, S.S. Bhavikatti, New Age International Publishers.2022. First Edition.

**3.** Basic Civil Engineering, Satheesh Gopi, Pearson Publications, 2009, First Edition.

**Reference Books:**


1. Surveying, Vol- I and Vol-II, S.K. Duggal, Tata McGraw Hill Publishers 2019. FifthEdition.
2. Hydrology and Water Resources Engineering, Santosh Kumar Garg, KhannaPublishers, Delhi. 2016
3. Irrigation Engineering and Hydraulic Structures - Santosh Kumar Garg, KhannaPublishers, Delhi 2023. 38th Edition.
4. Highway Engineering, S.K.Khanna, C.E.G. Justo and Veeraraghavan, Nemchand and Brothers Publications 2019. 10th Edition.
5. Indian Standard DRINKING WATER — SPECIFICATION IS 10500-2012.


## PART B: BASIC MECHANICAL ENGINEERING

**Course Objectives:**

The students after completing the course are expected to

- Get familiarized with the scope and importance of Mechanical Engineering in different sectors and industries.
- Explain different engineering materials and different manufacturing processes.
- Provide an overview of different thermal and mechanical transmission systems and introduce basics of robotics and its applications.

**UNIT I** **8 hours**

**Introduction to Mechanical Engineering:** Role of Mechanical Engineering in Industries andSociety-Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors.

**Engineering Materials** - Metals-Ferrous and Non-ferrous, Ceramics, Composites, Smart materials.

**UNIT II** **8 hours**

**Manufacturing Processes:** Principles of Casting**,** Forming, joining processes, Machining, Introduction to CNC machines, 3D printing, and Smart manufacturing.

**Thermal Engineering** – working principle of Boilers, Otto cycle, Diesel cycle, Refrigeration and air-conditioning cycles, IC engines, 2-Stroke and 4-Stroke engines, SI/CI Engines, Components of Electric and Hybrid Vehicles.

**UNIT III** **8 hours**

Power plants – working principle of Steam, Diesel, Hydro, Nuclear power plants. Mechanical Power Transmission - Belt Drives, Chain, Rope drives, Gear Drives and their applications.

Introduction to Robotics - Joints & links, configurations, and applications of robotics.

(Note: The subject covers only the basic principles of Civil and Mechanical Engineering systems. The evaluation shall be intended to test only the fundamentals of the subject)

**Course Outcomes:**

On completion of the course, the student should be able to

CO1: Understand the role and importance of mechanical engineering and engineering materials

CO2: Identify the different manufacturing processes for engineering applications and explain the basics of thermal engineering and its applications.

CO3: Explain the working of different mechanical power transmission systems, power plants and robotics.

**Text Books:**

1. Internal Combustion Engines by V.Ganesan, By Tata McGraw Hill publications (India)Pvt. Ltd.
2. A Tear book of Theory of Machines by S.S. Rattan, Tata McGraw Hill Publications,(India) Pvt. Ltd.
3. An introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, Cengagelearning India Pvt. Ltd.

**Reference Books:**

1. Appuu Kuttan KK, Robotics, I.K. International Publishing House Pvt. Ltd. Volume-I
2. 3D printing & Additive Manufacturing Technology- L. Jyothish Kumar, Pulak MPandey, Springer publications
3. Thermal Engineering by Mahesh M Rathore Tata McGraw Hill publications (India) Pvt.Ltd.
4. G. Shanmugam and M.S.Palanisamy, Basic Civil and the Mechanical Engineering, TataMcGraw Hill publications (India) Pvt. Ltd.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**B. Tech I Year I Semester**

## 23CSE101 INTRODUCTION TO PROGRAMMING

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Objectives:**

- Comprehensive knowledge to computer systems, programming languages, and problem-solving techniques.
- Know the concept of control structures and their usage in programming.
- Introduce to the arrays, memory models, and basic string concepts
- Gain a knowledge from the concept of functions, including declaration, definition, and various aspects of function usage.
- Acquire the advanced programming concepts, including user-defined data types, pointers, and file handling.

**UNIT I INTRODUCTION TO PROGRAMMING AND PROBLEM SOLVING** **9 hours**

History of Computers, Basic organization of a computer: ALU, input-output units, memory, program counter, Introduction to Programming Languages, Basics of a Computer Program- Algorithms, flowcharts (Using Dia Tool), pseudo code. Introduction to Compilation and Execution, Primitive Data Types, Variables, and Constants, Basic Input and Output, Operations, Type Conversion, and Casting. Problem solving techniques: Algorithmic approach, characteristics of algorithm, Problem solving strategies: Top-down approach, Bottom-up approach, Time and space complexities of algorithms.

**UNIT II CONTROL STRUCTURES** **9 hours**

Simple sequential programs Conditional Statements (if, if-else, switch), Loops (for, while, do- while) Break and Continue.

**UNIT III ARRAYS AND STRINGS** **9 hours**

Arrays indexing, memory model, programs with array of integers, two dimensional arrays, Introduction to Strings, String Operations and String functions.

**UNIT IV POINTERS & USER DEFINED DATA TYPES** **9 hours**

Pointers, dereferencing and address operators, pointer and address arithmetic, array manipulation using pointers, User-defined data types-Structures and Unions, Dynamic memory allocation.

**UNIT V FUNCTIONS & FILE HANDLING** **9 hours**

Introduction to Functions, Function Declaration and Definition, Function call Return Types and Arguments, modifying parameters inside functions using pointers, arrays as parameters. Scope and Lifetime of Variables, Basics of File Handling

**Note:** The syllabus is designed with C Language as the fundamental language of implementation**.**

**Course Outcomes:**

A student after completion of the course will be able to

CO1: Illustrate the basic computer concepts and programming principles of C language.

CO2: Develop programs using various control structures in 'C'.

CO3: Design applications using arrays and basic string manipulation.

CO4: Demonstrate the applications of pointers, user-defined types and dynamic memory allocation.

CO5: Design various applications using functions and file concepts.

**Text Books:**

**1.** C Programming, A Problem Solving Approach, Forouzan, Gilberg,Prasad, CENGAGE, 3rd edition.

**Reference Books:**

**1.** Computing fundamentals and C Programming, Balagurusamy, E., McGraw-HillEducation, 2008.

**2.** Programming in C, Rema Theraja, Oxford, 2016, 2nd edition

**3.** "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice-Hall, 1988

**4.** Schaum's Outline of Programming with C, Byron S Gottfried, McGraw-Hill Education,1996

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**B. Tech I Year I Semester**

## 23ENG201 COMMUNICATIVE ENGLISH LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Course Objectives:**

The main objective of introducing this course, Communicative English Laboratory, is to expose the students to a variety of self-instructional, learner friendly modes of language learning. The students will get trained in basic communication skills and also make them ready to face job interviews.

**List of Topics:**

1. Vowels & Consonants
2. Neutralization/Accent Rules
3. Communication Skills & JAM
4. Role Play or Conversational Practice
5. E-mail Writing
6. Resume Writing, Cover letter, SOP
7. Group Discussions-methods & practice
8. Debates - Methods & Practice
9. PPT Presentations/ Poster Presentation
10. Interviews Skills

**Course Outcomes:**

CO1: Understand the English speech sounds, stress, rhythm, intonation and syllabic division for better listening and speaking
CO2: Apply communication strategies and implement them in language learning activities.
CO3: Analyze and enhance job-relevant writing skills
CO4: Evaluate and exhibit professionalism in debates and group discussions.
CO5: Make effective presentations by developing public speaking abilities

**Suggested Software:**

1. Walden Infotech
2. Young India Films

**Reference Books:**

1. Raman Meenakshi, Sangeeta-Sharma. *Technical Communication*. Oxford Press.2018.
2. Taylor Grant: *English Conversation Practice*, Tata McGraw-Hill Education India,2016
3. Hewing's, Martin. Cambridge *Academic English* (B2). CUP, 2012.
4. J. Sethi & P.V. Dhamija. *A Course in Phonetics and Spoken English*, (2nd Ed),Kindle, 2013

**Web Resources:**

Spoken English:

1. www.esl-lab.com
2. www.englishmedialab.com
3. www.englishinteractive.net
4. https://www.britishcouncil.in/english/online
5. http://www.letstalkpodcast.com/
6. https://www.youtube.com/c/mmmEnglish_Emma/featured
7. https://www.youtube.com/c/ArnelsEverydayEnglish/featured
8. https://www.youtube.com/c/engvidAdam/featured
9. https://www.youtube.com/c/EnglishClass101/featured
10. https://www.youtube.com/c/SpeakEnglishWithTiffani/playlists
11. https://www.youtube.com/channel/UCV1h_cBE0Drdx19qkTM0WNw

**Voice & Accent:**

1. https://www.youtube.com/user/letstalkaccent/videos
2. https://www.youtube.com/c/EngLanguageClub/featured
3. https://www.youtube.com/channel/UC_OskgZBoS4dAnVUgJVexc
4. https://www.youtube.com/channel/UCNfm92h83W2i2ijc5Xwp_IA

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination

**B. Tech I Year I Semester**

## 23CHE201 ENGINEERING CHEMISTRY LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Course Objectives:**

- To verify the fundamental concepts with experiments

**List of Experiments:**

1. Determination of Hardness of a groundwater sample.
2. Estimation of Dissolved Oxygen by Winkler's method
3. Determination of Strength of an acid in Pb-Acid battery
4. Preparation of a polymer (Bakelite)
5. Determination of percentage of Iron in Cement sample by colorimetry
6. Estimation of Calcium in port land Cement
7. Preparation of nanomaterials by precipitation method.
8. Adsorption of acetic acid by charcoal
9. Determination of percentage Moisture content in a coal sample
10. Determination of Viscosity of lubricating oil by Redwood Viscometer 1
11. Determination of Viscosity of lubricating oil by Redwood Viscometer 2
12. Determination of Calorific value of gases by Junker's gas Calorimeter
13. Determination of Viscosity of a solution using Ostwald's Viscometer
14. Determination of cell constant and conductance of solutions

**Course Outcomes:**

At the end of the course, the students will be able to
CO1: Determine the cell constant and conductance of solutions.
CO2: Prepare advanced polymer materials.
CO3: Determine the physical properties like adsorption and viscosity.
CO4: Estimate the Iron and Calcium in cement.
CO5: Calculate the hardness of water.

**Reference Books:**

**1.** Vogel's Quantitative Chemical Analysis 6th Edition 6th Edition" Pearson Publications by J. Mendham, R.C. Denney, J.D. Barnes and B. Sivasankar
**2.** Textbook of Polymer Science, Fred W. Billmayer Jr, 3rd Edition

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination

**B. Tech I Year I Semester**

## 23CSE201 COMPUTER PROGRAMMING LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Course Objectives:**

- Provide hands-on experience in programming fundamentals, algorithm design, and basic problem-solving techniques.
- Enable students to implement control structures for program flow control in practical scenarios.
- Reinforce understanding of arrays, memory models, and string manipulation through practical exercises
- Provide hands-on practice with functions, function calls, and parameter manipulation using pointers.
- Offer practical exposure to advanced programming concepts, including user-defined data types, file handling, and pointer operations.

**UNIT I**

**WEEK 1**

**Objective:** Getting familiar with the programming environment on the computer and writingthe first program.

**Suggested Experiments/Activities:**

**Tutorial 1:** Problem-solving using Computers.

**Lab1:** Familiarization with programming environment

i) Basic Linux environment and its editors like Vi, Vim & Emacs etc.
ii) Exposure to Turbo C, gcc
iii) Writing simple programs using printf(), scanf()

**WEEK 2**

**Objective:** Getting familiar with how to formally describe a solution to a problem in a seriesof finite steps both using textual notation and graphic notation.

**Suggested Experiments /Activities:**

**Tutorial 2:** Problem-solving using Algorithms and Flow charts.

**Lab 1:** Converting algorithms/flow charts into C Source code.

Developing the algorithms/flowcharts for the following sample programs

i) Sum and average of 3 numbers
ii) Conversion of Fahrenheit to Celsius and vice versa

Simple interest calculation

**WEEK 3**

Objective: Learn how to define variables with the desired data-type, initialize them with appropriate values and how arithmetic operators can be used with variables and constants.

**Suggested Experiments/Activities:**
**Tutorial 3:** Variable types and type conversions:

**Lab 3:** Simple computational problems using arithmetic expressions.
**Problems to Practice:**

i) Finding the square root of a given number
ii) Finding compound interest
iii) Area of a triangle using heron's formulae
iv) Distance travelled by an object

**UNIT II**

**WEEK 4**
**Objective:** Explore the full scope of expressions, type-compatibility of variables & constantsand operators used in the expression and how operator precedence works.

**Suggested Experiments/Activities:**

**Tutorial4:** Operators and the precedence and as associativity:
**Lab4: Write C program to solve** Simple computational problems using the operator' precedence and associativity
**Problems to Practice:**

i) Evaluate the following expressions.
    a. A+B*C+(D*E) + F*G
    b. A/B*C-B+A*D/3
    c. A+++B---A
    d. J= (i++) + (++i)
ii) Find the maximum of three numbers using conditional operator
iii) Take marks of 5 subjects in integers, and find the total, average in float

**WEEK 5**
**Objective:** Explore the full scope of different variants of "if construct" namely if-else, null-else, if-else if*-else, switch and nested-if including in what scenario each one of them can be used and how to use them. Explore all relational and logical operators while writing conditionals for "if construct".

**Suggested Experiments/Activities:**
**Tutorial 5:** Branching and logical expressions:
**Lab 5**: Write C program for Problems involving if-then-else structures.
**Problems to Practice:**

i) Write a C program to find the max and min of four numbers using if-else.
ii) Write a C program to generate electricity bill.
iii) Find the roots of the quadratic equation.
iv) Write a C program to simulate a calculator using switch case.
v) Write a C program to find the given year is a leap year or not.

**WEEK 6**

**Objective:** Explore the full scope of iterative constructs namely while loop, do-while loop and for loop in addition to structured jump constructs like break and continue including when eachof these statements is more appropriate to use.

**Suggested Experiments/Activities:**
**Tutorial 6:** Loops, while and for loops
**Lab 6:** Write a C program for Iterative problems e.g., the sum of series
**Problems to Practice:**

i) Find the factorial of given number using any loop.
ii) Find the given number is a prime or not.
iii) Compute sine and cos series
iv) Checking a number palindrome
v) Construct a pyramid of numbers.

**UNIT III**

**WEEK 7:**
**Objective:** Explore the full scope of Arrays construct namely defining and initializing 1-D and 2-D and more generically n-D arrays and referencing individual array elements from the defined array. Using integer 1-D arrays, explore search solution linear search.

**Suggested Experiments/Activities:**
**Tutorial 7:** 1 D Arrays: searching.
**Lab 7:Write a C program to solve** 1D Array manipulation, linear search
**Problems to Practice:**

i) Find the min and max of a 1-D integer array.
ii) Perform linear search on1D array.
iii) The reverse of a 1D integer array
iv) Find 2's complement of the given binary number.
v) Eliminate duplicate elements in an array.

**WEEK 8:**
**Objective:** Explore the difference between other arrays and character arrays that can be usedas Strings by using null character and get comfortable with string by doing experiments that will reverse a string and concatenate two strings. Explore sorting solution bubble sort using integer arrays.

**Suggested Experiments/Activities:**
**Tutorial 8:** 2 D arrays, sorting and Strings.
**Lab 8: Write a C program to solve** Matrix problems, String operations, Bubble sort
**Problems to Practice:**

i) Addition of two matrices
ii) Multiplication two matrices
iii) Sort array elements using bubble sort

iv) Concatenate two strings without built-in functions
v) Reverse a string using built-in and without built-in string functions

**UNIT IV**

**WEEK 9:**

**Objective:** Explore pointers to manage a dynamic array of integers, including memory allocation & value initialization, resizing changing and reordering the contents of an array and memory de-allocation using malloc (), calloc (), realloc () and free () functions. Gainexperience processing command-line arguments received by C

**Suggested Experiments/Activities:**
**Tutorial 9:** Pointers, structures and dynamic memory allocation
**Lab 9: Write a C program for** Pointers and structures, memory dereference.
**Problems to Practice:**

i) Write a C program to find the sum of a 1D array using malloc()
ii) Write a C program to find the total, average of n students using structures
iii) Enter n students data using calloc() and display failed students list
iv) Read student name and marks from the command line and display the student details alongwith the total.
v) Write a C program to implement realloc()

**WEEK 10:**
**Objective:** Experiment with C Structures, Unions, bit fields and self-referential structures(Singly linked lists) and nested structures

**Suggested Experiments/Activities:**
**Tutorial 10:** Bitfields, Self-Referential Structures, Linked lists
**Lab10 :** Bitfields, linked lists
Read and print a date using dd/mm/yyyy format using bit-fields and differentiate the samewithout using bit- fields

i) Create and display a singly linked list using self-referential structure.
ii) Demonstrate the differences between structures and unions using a C program.
iii) Write a C program to shift/rotate using bitfields.
iv) Write a C program to copy one structure variable to another structure of the same type.

**UNIT V**

**WEEK 11:**
**Objective:** Explore the Functions, sub-routines, scope and extent of variables, doing some experiments by parameter passing using call by value. Basic methods of numerical integration

**Suggested Experiments/Activities:**
**Tutorial 11:** Functions, call by value, scope and extent,
**Lab 11:** Write a C program to solve Simple functions using call by value, solving differential equations using Eulers theorem.

**Problems to Practice:**

i) Write a C function to calculate NCR value.
ii) Write a C function to find the length of a string.

iii) Write a C function to transpose of a matrix.
iv) Write a C function to demonstrate numerical integration of differential equations using Euler'smethod

**WEEK 12:**

**Objective:** Explore how recursive solutions can be programmed by writing recursive functionsthat can be invoked from the main by programming at-least five distinct problems that have naturally recursive solutions.

**Suggested Experiments/Activities:**

**Tutorial 12:** Recursion, the structure of recursive calls

**Lab 12:** Write C program for Recursive functions.

**Problems to Practice:**

i) Write a recursive function to generate Fibonacci series.
ii) Write a recursive function to find the lcm of two numbers.
iii) Write a recursive function to find the factorial of a number.
iv) Write a C Program to implement Ackermann function using recursion.
v) Write a recursive function to find the sum of series.

**WEEK 13:**

**Objective:** Explore the basic difference between normal and pointer variables, Arithmetic operations using pointers and passing variables to functions using pointers

**Suggested Experiments/Activities:**

**Tutorial 13:** Call by reference, dangling pointers

**Lab 13:** Write a C program to solve Simple functions using Call by reference, Dangling pointers.

**Problems to Practice:**

i) Write a C program to swap two numbers using call by reference.
ii) Demonstrate Dangling pointer problem using a C program.
iii) Write a C program to copy one string into another using pointer.
iv) Write a C program to find no of lowercase, uppercase, digits and othercharacters using pointers.

**WEEK14:**

**Objective:** To understand data files and file handling with various file I/O functions. Explore thedifferences between text and binary files.

**Suggested Experiments/Activities:**

**Tutorial 14:** File handling

**Lab 14:** Write a C program to handle File operations.

**Problems to Practice:**

i) Write a C program to write and read text into a file.
ii) Write a C program to write and read text into a binary file using fread() and fwrite()
iii) Copy the contents of one file to another file.
iv) Write a C program to merge two files into the third file using command-linearguments.
v) Find no. of lines, words and characters in a file.

Write a C program to print last n characters of a given file.

**Course Outcomes:**

CO1: Implement coding and debugging the simple programs, create algorithms, and practice problem solving strategies using programming languages.

CO2: Demonstrate programs that incorporate conditional statements, loops, and break/continue statements to control program execution.

CO3: Apply coding for real time examples with arrays, array indexing, and manipulate strings in programming tasks.

CO4: Create, call, and debug functions, modify function parameters using pointers, and gain practical knowledge of variable scope within functions.

CO5: Apply user-defined data types, manipulate files, pointer operations to solve real-world programming challenges.

**Textbooks:**

**1.** Ajay Mittal, Programming in C: A practical approach, Pearson.

**2.** C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE

**Reference Books:**

**1.** Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice-Hall of India

**2.** Byron Gottfried, Schaum's Outline of Programming with C, McGraw Hill

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination

**B. Tech I Year I Semester**

## 23ME201 ENGINEERING WORKSHOP

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Course Objectives:**

To familiarize students with wood working, sheet metal operations, fitting and electrical house wiring skills

1. **Demonstration**: Safety practices and precautions to be observed in workshop.
2. **Wood Working:** Familiarity with different types of woods and tools used in wood working and make following joints.
   a) Half – Lap joint b) Mortise and Tenon joint c) Corner Dovetail joint or Bridlejoint
3. **Sheet Metal Working**: Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets.
   a) Tapered tray b) Conical funnel c) Elbow pipe d) Brazing
4. **Fitting:** Familiarity with different types of tools used in fitting and do the following fitting exercises.
   a) V-fit b) Dovetail fit c) Semi-circular fit d) Bicycle tire punctureand change of two-wheeler tyre
5. **Electrical Wiring**: Familiarity with different types of basic electrical circuits and make the following connections.
   a) Parallel and series b) Two-way switch c) Godown lighting
   d) Tube light e) Three phase motor f) Soldering of wires
6. **Foundry Trade:** Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds for given Patterns.
7. **Welding Shop**: Demonstration and practice on Arc Welding and Gas welding. Preparation of Lap joint and Butt joint.
8. **Plumbing:** Demonstration and practice of Plumbing tools, Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters.

**Course Outcomes:**

CO1: Identify workshop tools and their operational capabilities.
CO2: Practice on manufacturing of components using workshop trades including fitting, carpentry, foundry and welding.
CO3: Apply fitting operations in various applications.
CO4: Apply basic electrical engineering knowledge for House Wiring Practice

**Textbooks:**

**1.** Basic Workshop Technology: Manufacturing Process, Felix W.; Independently Published,2019. Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5th Edn. 2015.
**2.** A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai & Co., 2015 & 2017.

**Reference Books:**

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

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination

**B. Tech I Year I Semester**

**23HUM201 HEALTH AND WELLNESS, YOGA AND SPORTS**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 1 | 0.5 |

**Course Objectives:**

The main objective of introducing this course is to make the students maintain their mental and physical wellness by balancing emotions in their life. It mainly enhances the essential traits required for the development of the personality.

**UNIT** I **5 hours**

Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index (BMI) of all age groups.

**Activities:**

i) Organizing health awareness programmes in community
ii) Preparation of health profile
iii) Preparation of chart for balance diet for all age groups

**UNIT II** **5 hours**

Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.

**Activities:**

Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

**UNIT III** **5 hours**

Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games.

**Activities:**

i) Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc.
ii) Practicing general and specific warm up, aerobics
iii) Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.

**Course Outcomes:**

After completion of the course the student will be able to

CO1: Understand the importance of yoga and sports for Physical fitness and sound health.
CO2: Demonstrate an understanding of health-related fitness components.
CO3: Compare and contrast various activities that help enhance their health.
CO4: Assess current personal fitness levels.
CO5: Develop Positive Personality

**Reference Books:**

1. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning,2022
2. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice
3. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
4. Wiseman, John Lofty,
5. The Sports Rules Book/ Human Kinetics with Thomas Hanlon. -- 3rd ed. HumanKinetics, Inc.2014

**General Guidelines:**

1. Institutes must assign slots in the Timetable for the activities of Health/Sports/Yoga.
2. Institutes must provide field/facility and offer the minimum of five choices of as manyas Games/Sports.
3. Institutes are required to provide sports instructor / yoga teacher to mentor the students.

**Evaluation Guidelines:**

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting vivavoce on the subject.

# I Year II Semester

**B. Tech I Year II Semester**

**23MAT102 DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Objectives:**

- To enlighten the learners in the concept of differential equations and multivariable calculus.
- To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real-world applications.

**UNIT I DIFFERENTIAL EQUATIONS OF FIRST ORDER AND FIRST DEGREE** **9 hours**

Linear differential equations – Bernoulli's equations- Exact equations and equations reducible to exact form. Applications: Newton's Law of cooling – Law of natural growth and decay- Electrical circuits.

**UNIT II LINEAR DIFFERENTIAL EQUATIONS OF HIGHER ORDER (CONSTANT COEFFICIENTS)** **9 hours**

Definitions, homogenous and non-homogenous, complimentary function, general solution, particular integral, Wronskian, Method of variation of parameters. Simultaneous linear equations, Applications to L-C-R Circuit problems and Simple Harmonic motion.

**UNIT III PARTIAL DIFFERENTIAL EQUATIONS** **9 hours**

Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method. Homogeneous Linear Partial differential equations with constant coefficients.

**UNIT IV VECTOR DIFFERENTIATION** **9 hours**

Scalar and vector point functions, vector operator Del, Del applies to scalar point functions- Gradient, Directional derivative, del applied to vector point functions-Divergence and Curl, vector identities.

**UNIT V VECTOR INTEGRATION** **9 hours**

Line Integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and related problems.

**Course Outcomes:**

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

CO1: Find the solution of engineering problems formulated in the form of linear first order differential equations.

CO2: Solve the linear higher order differential equations related to various engineering fields.

CO3: Determine the solutions for linear partial differential equations that model the physical processes.

CO4: Interpret the physical meaning of different operators such as gradient, curl and divergence.

CO5: Estimate the work done against field, circulation and flux using vector calculus.

**Text Books:**

**1.** Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 2017, 44th Edition

**2.** Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons, 2018, 10thEdition.

**Reference Books:**

**1.** Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, PearsonPublishers, 2018, 14th Edition.

**2.** Advanced Engineering Mathematics, Dennis G. Zill and Warren S. Wright, Jones andBartlett, 2018.

**3.** Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018,5th Edition.

**4.** Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha ScienceInternational Ltd., 2021 5th Edition (9th reprint).

**5.** Higher Engineering Mathematics, B. V. Ramana, , McGraw Hill Education, 2017

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**B. Tech I Year II Semester**

## 23PHY101 ENGINEERING PHYSICS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Objectives:**

To bridge the gap between the Physics in school at 10+2 level and UG level engineering courses by identifying the importance of the optical phenomenon like interference, diffraction etc, enlightening the periodic arrangement of atoms in crystalline solids and concepts of quantum mechanics, introduce novel concepts of dielectric and magnetic materials, physics of semiconductors.

### UNIT I WAVE OPTICS 9 hours

Interference: Introduction - Principle of superposition –Interference of light - Interference in thin films (Reflection Geometry) & applications - Colours in thin films- Newton's Rings, Determination of wavelength and refractive index.

Diffraction: Introduction - Fresnel and Fraunhofer diffractions - Fraunhofer diffraction due to single slit, double slit & N-slits (Qualitative) – Diffraction Grating - Dispersive power and resolving power of Grating (Qualitative). Polarization: Introduction -Types of polarization - Polarization by reflection, refraction and Double refraction - Nicol's Prism -Half wave and Quarter wave plates.

### UNIT II CRYSTALLOGRAPHY AND X-RAY DIFFRACTION 9 hours

Crystallography: Space lattice, Basis, Unit Cell and lattice parameters – Bravais Lattices – crystal systems (3D) – coordination number - packing fraction of SC, BCC & FCC - Miller indices – separation between successive (hkl) planes.

X-ray diffraction: Bragg's law - X-ray Diffractometer – crystal structure determination by Laue's and powder methods

### UNIT III QUANTUM MECHANICS AND FREE ELECTRON THEORY 9 hours

Quantum Mechanics: Dual nature of matter – Heisenberg's Uncertainty Principle – Significance and properties of wave function – Schrodinger's time independent and dependent wave equations– Particle in a one-dimensional infinite potential well.

Free Electron Theory: Classical free electron theory (Qualitative with discussion of merits and demerits) – Quantum free electron theory – electrical conductivity based on quantum free electron theory - Fermi-Dirac distribution - Density of states - Fermi energy

### UNIT IV SEMICONDUCTORS 9 hours

Semiconductors: Formation of energy bands – classification of crystalline solids - Intrinsic semiconductors: Density of charge carriers – Electrical conductivity – Fermi level – Extrinsic semiconductors: density of charge carriers – dependence of Fermi energy on carrier concentration and temperature - Drift and diffusion currents – Einstein's equation – Hall effect and its applications.

### UNIT V DIELECTRIC AND MAGNETIC MATERIALS 9 hours

Dielectric Materials: Introduction - Dielectric polarization - Dielectric polarizability, Susceptibility, Dielectric constant and Displacement Vector – Relation between the electric vectors - Types of polarizations- Electronic (Quantitative), Ionic (Quantitative) and Orientation polarizations (Qualitative) - Lorentz internal field - Clausius- Mossotti equation - complex dielectric constant – Frequency dependence of polarization – dielectric loss

Magnetic Materials: Introduction - Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability – Atomic origin of magnetism - Classification of magnetic materials: Dia, para, Ferro,

anti-ferro & Ferri magnetic materials - Domain concept for Ferromagnetism & Domain walls (Qualitative) - Hysteresis - soft and hard magnetic materials.

**Course Outcomes:**

**CO1:** Apply the knowledge of Interference, Diffraction and Polarization techniques for materials testing and explore their applications in both science and technology.

**CO2:** Explain the crystal structure in terms of atomic positions, unit cells, and crystal symmetry and also relate the crystal symmetry to the symmetry observed in a diffraction pattern.

**CO3**: Evaluate the Schrodinger wave equations for simple potentials and explain the concept of conductivity of different types of materials.

**CO4:** Distinguish the semiconductors using Fermi level and identify the type of semiconductors using Hall effect.

**CO5:** Explain the origin of fundamental magnetic phenomena and types of magnetic materials. Understand the induced fields in dielectrics, and electrical behaviour of dielectrics.

**Text Books:**

**1.** A Text book of Engineering Physics, M. N. Avadhanulu, P.G.Kshirsagar & TVS ArunMurthy, S. Chand Publications, 11th Edition 2019.

**2.** Engineering Physics - D.K.Bhattacharya and Poonam Tandon, Oxford press (2015)

**Reference Books:**

**1.** Engineering Physics - B.K. Pandey and S. Chaturvedi, Cengage Learning 2021.

**2.** Engineering Physics - Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018.

**3.** Engineering Physics" - Sanjay D. Jain, D. Sahasrabudhe and Girish, University Press.2010

**4.** Engineering Physics - M.R. Srinivasan, New Age international publishers (2009).

**Web Resources:** https://www.loc.gov/rr/scitech/selected-internet/physics.html

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**B. Tech I Year II Semester**

**23EEE101 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Objectives:**

- To expose to the field of electrical & electronics engineering, laws and principles of electrical/ electronic engineering and to acquire fundamental knowledge in the relevant field.

## PART A: BASIC ELECTRICAL ENGINEERING

### UNIT I DC & AC CIRCUITS 8 hours

**DC Circuits:** Electrical circuit elements (R, L and C), Ohm's Law and its limitations, KCL & KVL, series, parallel, series-parallel circuits, Super Position theorem, Simple numerical problems.

**AC Circuits:** A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor, Voltage and current relationship with phasor diagrams in R, L, and C circuits, Concept of Impedance, Active power, reactive power and apparent power, Concept of power factor (Simple Numerical problems).

### UNIT II MACHINES AND MEASURING INSTRUMENTS 8 hours

**Machines**: Construction, principle and operation of (i) DC Motor, (ii) DC Generator, (iii) Single Phase Transformer, (iv) Three Phase Induction Motor and (v) Alternator, Applications of electrical machines.

**Measuring Instruments:** Construction and working principle of Permanent Magnet Moving Coil (PMMC), Moving Iron (MI) Instruments and Wheat Stone bridge.

### UNIT III ENERGY RESOURCES, ELECTRICITY BILL & SAFETY MEASURES 8 hours

**Energy Resources:** Conventional and non-conventional energy resources; Layout and operation of various Power Generation systems: Hydel, Nuclear, Solar & Wind power generation.

**Electricity bill:** Power rating of household appliances including air conditioners, PCs, Laptops,Printers, etc. Definition of "unit" used for consumption of electrical energy, two-part electricitytariff, calculation of electricity bill for domestic consumers.

**Equipment Safety Measures:** Working principle of Fuse and Miniature circuit breaker(MCB), merits and demerits. Personal safety measures: Electric Shock, Earthing and its types,Safety Precautions to avoid shock

**Course Outcomes:**

After the completion of the course students will be able to

CO1: Infer the basic AC and DC electrical circuits.

CO2: Analyze construction and operation of AC and DC machines, different electrical measuring instruments.

CO3: Illustrate operation of various power generating stations, energy consumption and electrical safety.

**Text Books:**


1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, FirstEdition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti,Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, ThirdEdition


**Reference Books:**


1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019,Fourth Edition
2. Principles of Power Systems, V.K. Mehtha, S.Chand Technical Publishers, 2020
3. Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford UniversityPress, 2017
4. Basic Electrical and Electronics Engineering, S. K. Bhatacharya, Person Publications,2018, Second Edition.


**Web Resources:**

1. https://nptel.ac.in/courses/108105053
2. https://nptel.ac.in/courses/108108076

## PART B: BASIC ELECTRONICS ENGINEERING

**Course Objectives:**

This course provides the student with the fundamental skills to understand the principles of digital electronics, basics of semiconductor devices like diodes & transistors, characteristics and its applications.

### UNIT I SEMICONDUCTOR DEVICES 8 hours

Introduction - Evolution of electronics – Vacuum tubes to nano electronics - Characteristics of PN Junction Diode — Zener Effect — Zener Diode and its Characteristics. Bipolar Junction Transistor - CB, CE, CC Configurations and Characteristics — Elementary Treatment of Small Signal CE Amplifier.

### UNIT II BASIC ELECTRONIC CIRCUITS AND INSTRUMENTTAION 8 hours

Rectifiers and power supplies: Block diagram description of a dc power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response. Electronic Instrumentation: Block diagram of an electronic instrumentation system.

### UNIT III DIGITAL ELECTRONICS 8 hours

Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Boolean Algebra, Basic Theorems and properties of BooleanAlgebra, Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. Simple

combinational circuits–Half and Full Adder, Introduction to sequential circuits, Flip flops, Registers and counters (Elementary Treatment only)

**Course Outcomes:**

After the completion of the course students will be able to

CO1: Explain the theory, construction, and operation of electronic devices.

CO2: Apply the concept of science and mathematics to explain the working of diodes, transistors, and their applications.

CO3: Analyze logic gates and its applications in design of combinational circuits.

**Text Books:**

**1.** R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, PearsonEducation, 2021.

**2.** R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009

**Reference Books:**

**1.** R. S. Sedha, A Textbook of Electronic Devices and Circuits, S. Chand & Co, 2010.

**2.** Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India, 2002.

**3.** R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version,Pearson Education,2009.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**B. Tech I Year II Semester**

## 23ME101 ENGINEERING GRAPHICS

| L | T | P | C |
|---|---|---|---|
| 1 | 0 | 4 | 3 |

**Course Objectives:**

- To enable the students with various concepts like dimensioning, conventions and standards related to Engineering Drawing.
- To impart knowledge on the projection of points, lines and plane surfaces
- To improve the visualization skills for better understanding of projection of solids
- To develop the imaginative skills of the students required to understand Section of solids and Developments of surfaces.
- To make the students understand the viewing perception of a solid object in Isometric and Perspective projections.

**UNIT I** **9 hours**

Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing regular polygons by general methods.
Curves: construction of ellipse, parabola and hyperbola by general, Cycloids, Involutes, Normal and tangent to Curves.
Scales: Plain scales, diagonal scales and vernier scales.

**UNIT II** **9 hours**

Orthographic Projections: Reference plane, importance of reference lines or Plane, Projections of a point situated in any one of the four quadrants.
Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes
Projections of Planes: regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

**UNIT III** **9 hours**

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical plane and Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to another plane.

**UNIT IV** **9 hours**

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shape of section, Sections of solids in simple position only.
Development of Surfaces: Methods of Development: Parallel line development and radial line development. Development of a cube, prism, cylinder, pyramid and cone.

**UNIT V** **9 hours**

Conversion of Views: Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views.

Computer graphics: Creating 2D&3D drawings ofobjects including PCB and Transformations using Auto CAD (Not for end examination).

**Course Outcomes:**

Students will use the Auto CAD software and will be able to

CO1: Construct the geometrical constructions, engineering curves and scales.
CO2: Draw the projections of points, straight lines and planes
CO3: Draw the projections of solids in various positions
CO4: Sketch the sections of solids and developments of surfaces
CO5: Draw the conversion of the isometric views to orthographic views and vice versa.

**Text Books:**

**1.** N. D. Bhatt, Engineering Drawing, Charotar Publishing House, 2016.

**Reference Books:**

**1.** Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2013.

**2.** Engineering Drawing, M.B.Shah and B.C. Rana, Pearson Education Inc,2009.

**3.** Engineering Drawing with an Introduction to AutoCAD, Dhananjay Jolhe, TataMcGraw Hill, 2017.

**Mode of Evaluation:** Day-to-day Evaluation, Mid Term Tests and End Semester Examination.

**B. Tech I Year II Semester**

## 23ME102 ENGINEERING MECHANICS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Objectives:**

- To get familiarized with different types of force systems.
- To draw accurate free body diagrams representing forces and moments acting on a body to analyze the equilibrium of system of forces.
- To teach the basic principles of center of gravity, centroid and moment of inertia and determine them for different simple and composite bodies.
- To apply the Work-Energy method to particle motion.
- To understand the kinematics and kinetics of translational and rotational motion of rigid bodies.

**UNIT I** **9 hours**

Introduction to Engineering Mechanics– Basic Concepts. Scope and Applications
Systems of Forces: Coplanar Concurrent Forces– Components in Space–Resultant–Moment of Force and its Application –Couples and Resultant of Force Systems.
Friction: Introduction, limiting friction and impending motion, Coulomb'slaws of dryfriction, coefficient of friction, Cone of Static friction.

**UNIT II** **9 hours**

**Equilibrium of Systems of Forces:** Free Body Diagrams, Lami's Theorm, Equations of Equilibrium of Coplanar Systems, Graphical method for the equilibrium, Triangle law of forces,converse of the law of polygon of forces condition of equilibrium, Equations of Equilibrium forSpatial System of forces, Numerical examples on spatial system of forces using vector approach, Analysis of plane trusses.

**UNIT III** **9 hours**

**Centroid**: Centroids of simple figures (from basic principles)–Centroids of Composite Figures. Centre of Gravity: Centre of gravity of simple body (from basic principles), Centre of gravity of composite bodies, Pappus theorems..
**Area Moments of Inertia:** Definition– Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia.
Mass Moment of Inertia: Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, Mass Moment of Inertia of composite bodies.

**UNIT IV** **9 hours**

Rectilinear and Curvilinear motion of a particle: Kinematics and Kinetics –D'Alembert's Principle - Work Energy method and applications to particle motion-Impulse Momentum method.

**UNIT V** **9 hours**

Rigid body Motion: Kinematics and Kinetics of translation, Rotation about fixed axis and plane motion, Work Energy method and Impulse Momentum method.

**Course Outcomes:**

On Completion of the course, the student should be able to

**CO1:** Understand the fundamental concepts in mechanics and determine the frictional forces for bodies in contact.

**CO2**: Analyze different force systems such as concurrent, coplanar and spatial systems andcalculate their resultant forces and moments.

**CO3**: Calculate the centroids, center of gravity and moment of inertia of different geometricalshapes.

**CO4:** Apply the principles of work-energy and impulse-momentum to solve the problems of rectilinear and curvilinear motion of a particle.

**CO5:** Solve the problems involving the translational and rotational motion of rigid bodies.

**Text Books:**


1. Engineering Mechanics, S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., , McGraw HillEducation 2017. 5th Edition.
2. Engineering Mechanics, P.C.Dumir- S.Sengupta and Srinivas V veeravalli , Universitypress. 2020. First Edition.
3. A Textbook of Engineering Mechanics, S.S Bhavikatti. New age internationalpublications 2018. 4th Edition.


**Reference Books:**


1. Engineering Mechanics, Statics and Dynamics, Rogers and M A. Nelson., McGraw HillEducation. 2017. First Edition.
2. Engineering Mechanics, Statics and Dynamics, I.H. Shames., PHI, 2002. 4th Edition.
3. Engineering Mechanics, Volume-I: Statics, Volume-II: Dynamics, J. L. Meriam and L. G. Kraige., John Wiley, 2008. 6th Edition.
4. Introduction to Statics and Dynamics, Basudev Battachatia, Oxford University Press,2014. Second Edition
5. Engineering Mechanics: Statics and Dynamics, Hibbeler R.C., Pearson Education, Inc., New Delhi, 2022, 14th Edition


**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**B. Tech I Year II Semester**

## 23PHY201 ENGINEERING PHYSICS LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Course Objectives:**

To study the concepts of optical phenomenon like interference, diffraction etc., recognize the importance of energy gap in the study of conductivity and Hall effect in semiconductors and study the parameters and applications of dielectric and magnetic materials by conducting experiments.

**List of Experiments:**

1. Determination of radius of curvature of a given Plano-convex lens by Newton's rings.
2. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration.
3. Verification of Brewster's law
4. Determination of dielectric constant using charging and discharging method.
5. Study the variation of B versus H by magnetizing the magnetic material (B-H curve).
6. Determination of wavelength of Laser light using diffraction grating.
7. Estimation of Planck's constant using photoelectric effect.
8. Determination of the resistivity of semiconductors by four probe methods.
9. Determination of energy gap of a semiconductor using p-n junction diode.
10. Magnetic field along the axis of a current carrying circular coil by Stewart Gee's Method.
11. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect.
12. Determination of temperature coefficients of a thermistor.
13. Determination of acceleration due to gravity and radius of Gyration by using a Compound pendulum.
14. Determination of magnetic susceptibility by Kundt's tube method.
15. Determination of rigidity modulus of the material of the given wire using Torsional pendulum.
16. Sonometer: Verification of laws of stretched string.
17. Determination of young's modulus for the given material of wooden scale by non-uniform bending (or double cantilever) method.
18. Determination of Frequency of electrically maintained tuning fork by Melde's experiment.

**Note**: Any TEN of the listed experiments are to be conducted. Out of which any TWO experiments may be conducted in virtual mode.

**Course Outcomes:**

**CO1:** Know the various phenomena of light practically and gain knowledge about various optical technique methods.

**CO2:** Verify the theoretical concepts of optics, magnetism and dielectrics by hands on experiment.

**CO3:** Apply the scientific process in the conduct of semiconductor experiments and report the experimental findings.

**CO4:** Understand mechanical phenomena by instruments and apply them in real time applications.

**CO5:** Acquire and interpret experimental data to examine the physical laws.

**Web Resources:**

www.vlab.co.in
https://phet.colorado.edu/en/simulations/filter?subjects=physics&type=html,prototype

**Reference Books:**

**1.** A Textbook of Practical Physics - S. Balasubramanian, M.N. Srinivasan, S. Chand Publishers, 2017.

**2.** Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.

**3.** Wiring Estimating, Costing and Contracting; Soni P.M. & Upadhyay P.A.; AtulPrakashan, 2021-22.

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination

**B. Tech I Year II Semester**

**23EEE201 ELECTRICAL AND ELECTRONICS ENGINEERING WORKSHOP**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Course Objectives:**

To impart knowledge on the fundamental laws & theorems of electrical circuits, functions of electrical machines and energy calculations.

**Activities:**

1. Familiarization of commonly used Electrical & Electronic Workshop Tools: Bread board, Solder, cables, relays, switches, connectors, fuses, Cutter, plier, screwdriver set,wire stripper, flux, knife/blade, soldering iron, de-soldering pump etc.
   - Provide some exercises so that hardware tools and instruments are learned to be usedby the students.
2. Familiarization of Measuring Instruments like Voltmeters, Ammeters, multimeter, LCR-Q meter, Power Supplies, CRO, DSO, Function Generator, Frequency counter.
   - Provide some exercises so that measuring instruments are learned to be used by thestudents.
3. Components:
   - Familiarization/Identification of components (Resistors, Capacitors, Inductors, Diodes, transistors, IC's etc.) – Functionality, type, size, colour coding package, symbol, cost etc.
   - Testing of components like Resistor, Capacitor, Diode, Transistor, ICs etc. - Compare values of components like resistors, inductors, capacitors etc with the measured values by using instruments

**PART A: ELECTRICAL ENGINEERING LABORATORY**

**List of experiments:**

1. Verification of KCL and KVL
2. Verification of Superposition theorem
3. Measurement of Resistance using Wheat stone bridge
4. Magnetization Characteristics of DC shunt Generator
5. Measurement of Power and Power factor using Single-phase wattmeter
6. Measurement of Earth Resistance using Megger
7. Calculation of Electrical Energy for Domestic Premises

Note: Minimum Six Experiments to be performed.

**Course Outcomes:**

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

CO1: Analyze basic DC circuits.

CO2: Understand the usage of common electrical & electronic measuring instruments.

CO3: Understand the basic characteristics of electrical machines and perform energy calculations.

## PART B: ELECTRONICS ENGINEERING LABORATORY

**Course Objectives:**

- To impart knowledge on the principles of digital electronics and fundamentals of electron devices & its applications.

**List of Experiments:**

1. Plot V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias.
2. Plot V – I characteristics of Zener Diode and its application as voltage Regulator.
3. Implementation of half wave and full wave rectifier.
4. Plot Input & Output characteristics of BJT in CE and CB configurations
5. Frequency response of CE amplifier.
6. Simulation of RC coupled amplifier with the design supplied
7. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gatesusing ICs.
8. Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs.

**Tools / Equipment Required:** DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters,AC Voltmeters, CROs, all the required active devices.

**Note**: Minimum Six Experiments to be performed. All the experiments shall be implemented using Hardware / Software.

**Course Outcomes:**

At the end of the course, the student will be able to
CO1: Plot and discuss the characteristics of various electron devices.
CO2: Explain the operation of a digital circuit.

**Reference Books:**

**1.** R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, PearsonEducation, 2021.
**2.** R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009
**3.** R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version,Pearson Education,2009.

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination

**B. Tech I Year II Semester**

## 23ME202 ENGINEERING MECHANICS LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Course Objectives:**

The students completing the course are expected to:

- Verify the Law of Parallelogram and Triangle of Forces.
- Determine the coefficients of friction of Static and Rolling friction and Centre of gravity of different plane Lamina.
- Analyse the system of Pulleys and Moment of Inertia of Compound Pendulum and Flywheel.

Students have to perform any 10 of the following Experiments:

**List of Experiments:**

1. Verification of Law of Parallelogram of Forces.
2. Verification of Law of Triangle of Forces.
3. Verification of the Law of polygon for coplanar-concurrent forces acting on a particle in equilibrium and to find the value of unknown forces considering particle to be in equilibrium using universal force table.
4. Determination of coefficient of Static and Rolling Frictions
5. Determination of Centre of Gravity of different shaped Plane Lamina.
6. Verification of the conditions of equilibrium of a rigid body under the action of coplanar non- concurrent, parallel force system with the help of a simply supported beam.
7. Study of the systems of pulleys and draw the free body diagram of the system.
8. Determine the acceleration due to gravity using a compound pendulum.
9. Determine the Moment of Inertia of the compound pendulum about an axis perpendicular to the plane of oscillation and passing through its centre of mass.
10. Determine the Moment of Inertia of a Flywheel.
11. Verification of Law of Moment using Rotation Disc Apparatus and Bell Crank Lever.

**Course Outcomes:**

CO1: Verify Law of Polygon of forces and Law of Moment using force polygon and bell crank lever.
CO2: Evaluate the coefficient of friction between two different surfaces and between the inclined plane and the roller.
CO3: Determine the Centre of gravity and Moment of Inertia of different configurations.
CO4: Verify the equilibrium conditions of a rigid body under the action of different force systems using free body diagrams .
CO5: Determine the Moment of Inertia compound pendulum and flywheel

**Text Books:**

1. Engineering Mechanics, S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., , McGraw HillEducation 2017. 5th Edition.
2. Lab Manual provided by the department

**Reference Books:**

1. S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., Engineering Mechanics, 5th Edition, McGraw Hill Education.
2. Hibbeler R.C., Engineering Mechanics: Statics and Dynamics, 14th Edition, Pearson Education, Inc., New Delhi, 2022

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination

**B. Tech I Year II Semester**

## 23CSE202 IT WORKSHOP

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Course Objectives:**

- To introduce the internal parts of a computer, peripherals, I/O ports, connecting cables
- To demonstrate configuring the system as Dual boot both Windows and other Operating Systems Viz. Linux, BOSSTo teach basic command line interface commands on Linux.
- To teach the usage of Internet for productivity and self-paced life-long learning
- To introduce Compression, Multimedia and Antivirus tools and Office Tools such as Word processors, Spread sheets and Presentation tools.

**PC Hardware & Software Installation**

**Task 1:** Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.

**Task 2:** Every student should disassemble and assemble the PC back to working condition. Labinstructors should verify the work and follow it up with a Viva. Also students need to go throughthe video which shows the process of assembling a PC. A video would be given as part of the course content.

**Task 3**: Every student should individually install MS windows on the personal computer. Labinstructor should verify the installation and follow it up with a Viva.

**Task 4:** Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot (VMWare) with both Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva

**Task 5:** Every student should install BOSS on the computer. The system should be configuredas dual boot (VMWare) with both Windows and BOSS. Lab instructors should verify the installation and follow it up with a Viva

**Internet & World Wide Web**

**Task1:** Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finallystudents should demonstrate, to the instructor, how to access the websites and email. If there isno internet connectivity preparations need to be made by the instructors to simulate the WWW on the LAN.

**Task 2**: Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.

**Task 3:** Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student.

**Task 4:** Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms.

**LaTeX and WORD**
**Task 1** – Word Orientation: The mentor needs to give an overview of La TeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of La TeX and MS office or equivalent (FOSS) tool Word as word Processors, Details of the four tasks and features that would be covered in each, Using La TeXand word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter in word.

**Task 2:** Using La TeX and Word to create a project certificate. Features to be covered:- Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both La TeX and Word.

**Task 3:** Creating project abstract Features to be covered:-Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes.

**Task 4**: Creating a Newsletter: Features to be covered:- Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word.

**EXCEL**
Excel Orientation: The mentor needs to tell the importance of MS office or equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources.
**Task 1**: Creating a Scheduler - Features to be covered: Gridlines, Format Cells, Summation, auto fill, Formatting Text

**Task 2:** Calculating GPA -. Features to be covered:- Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function,

**LOOKUP/VLOOKUP**
**Task 3:** Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting

**POWER POINT**
**Task 1:** Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint.

**Task 2**: Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts.

**Task 3**: Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting – Background, textures, Design Templates, Hidden slides.

**AI TOOLS – ChatGPT**
**Task 1**: Prompt Engineering: Experiment with different types of prompts to see how the model responds. Try asking questions, starting conversations, or even providing incomplete sentences to see how the model completes them.
- Ex: Prompt: "You are a knowledgeable AI. Please answer the following question: What is the capital of France?"

**Task 2**: Creative Writing: Use the model as a writing assistant. Provide the beginning of a story or a description of a scene, and let the model generate the rest of the content. This can be a fun way to brainstorm creative ideas

- Ex: Prompt: "In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality."

**Task 3**: Language Translation: Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output to see how accurate and fluent the translations are.

- Ex:Prompt: "Translate the following English sentence to French: 'Hello, how are you doing today?'"

**Course Outcomes:**

CO1: Gain expertise in computer hardware, assembly, and dual-boot OS configuration, enhancing their ability to manage and troubleshoot computer systems effectively.
CO2: Learn to connect to the LAN, configure browsers, use search engines effectively, and practice cyber hygiene for secure internet use.
CO3: Create well-formatted documents and presentations using Microsoft Office and Latex
CO4: Gain proficiency in using Excel or its FOSS equivalent for tasks like scheduling, GPA calculation, data manipulation, and formatting.
CO5: Craft effective and tailored inputs to obtain desired responses from AI tools like ChatGPT.

**Reference Books:**

1. Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream tech, 2003
2. The Complete Computer upgrade and repair book, Cheryl A Schmidt, WILEY Dream tech,2013, 3rd edition
3. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education, 2012, 2nd edition
4. PC Hardware - A Handbook, Kate J. Chase, PHI (Microsoft)
5. LaTeX Companion, Leslie Lamport, PHI/Pearson.
6. IT Essentials PC Hardware and Software Companion Guide, David Anfins on and KenQuamme. – CISCO Press, Pearson Education, 3rd edition
7. IT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan– CISCOPress, Pearson Education, 3rd edition

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination

**B. Tech I Year II Semester**

**23HUM202 NSS/NCC/SCOUTS AND GUIDES/COMMUNITY SERVICE**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 1 | 0.5 |

**Course Objectives:**

The objective of introducing this course is to impart discipline, character, fraternity, teamwork, social consciousness among the students and engaging them in selfless service.

**UNIT I ORIENTATION** **5 hours**

General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, careerguidance.

**Activities:**

i) Conducting –ice breaking sessions-expectations from the course-knowing personaltalents and skills
ii) Conducting orientations programs for the students –future plans-activities-releasingroad map etc.
iii) Displaying success stories-motivational biopics- award winning movies on societalissues etc.
iv) Conducting talent show in singing patriotic songs-paintings- any other contribution.

**UNIT II NATURE & CARE** **5 hours**

**Activities:**

i) Best out of waste competition.
ii) Poster and signs making competition to spread environmental awareness.
iii) Recycling and environmental pollution article writing competition.
iv) Organising Zero-waste day.
v) Digital Environmental awareness activity via various social media platforms.
vi) Virtual demonstration of different eco-friendly approaches for sustainable living.
vii) Write a summary on any book related to environmental issues.

**UNIT III COMMUNITY SERVICE** **5 hours**

**Activities:**

i) Conducting One Day Special Camp in a village contacting village-area leaders-Surveyin the village, identification of problems- helping them to solve via media-authorities-experts-etc.
ii) Conducting awareness programs on Health-related issues such as General Health, Mental health, Spiritual Health, HIV/AIDS,
iii) Conducting consumer Awareness. Explaining various legal provisions etc.
iv) Women Empowerment Programmes- Sexual Abuse, Adolescent Health and PopulationEducation.
v) Any other programmes in collaboration with local charities, NGOs etc.

**Course Outcomes:**

After completion of the course the students will be able to

**CO1:** Understand the importance of discipline, character and service motto.
**CO2:** Solve some societal issues by applying acquired knowledge, facts, and techniques.
**CO3:** Explore human relationships by analyzing social problems.
**CO4:** Determine to extend their help for the fellow beings and downtrodden people.
**CO5:** Develop leadership skills and civic responsibilities.

**Reference Books:**

1. Nirmalya Kumar Sinha & Surajit Majumder, *A Text Book of National Service Scheme*
2. Vol;.I, Vidya Kutir Publication, 2021 ( ISBN 978-81-952368-8-6)
3. *Red Book - National Cadet Corps* – Standing Instructions Vol I & II, DirectorateGeneral of NCC, Ministry of Defence, New Delhi
4. Davis M. L. and Cornwell D. A., "Introduction to Environmental Engineering",McGraw Hill, New York 4/e 2008
5. Masters G. M., Joseph K. and Nagendran R. "Introduction to EnvironmentalEngineering and Science", Pearson Education, New Delhi. 2/e 2007

**General Guidelines:**

1. Institutes must assign slots in the Timetable for the activities.
2. Institutes are required to provide instructor to mentor the students.

**Evaluation Guidelines:**

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalling to 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting vivavoce on the subject.

# II Year I Semester

**B. Tech II Year I Semester**

**23HUM101 UNIVERSAL HUMAN VALUES**

| L | T | P | C |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

**Course Prerequisite:** None or Universal Human Values-I (desirable).

**Course Description :**

The course has 28 lectures and 14 tutorials in 5 Units. The lectures and tutorials are of 1-hour duration. Tutorial sessions are to be used to explore and practice what has been proposed during the lecture sessions. The Teacher's Manual provides the outline for lectures as well as practice sessions. The teacher is expected to present the issues to be discussed as propositions and encourage the students to have a dialogue.

**Course Objectives:** None. Universal Human Values-I (desirable)

The main objectives of the course is to

1. help the students appreciate the essential complementary between 'VALUES' and 'SKILLS' to ensure happiness and prosperity in continuity, which are the core aspirations of all human beings.
2. facilitate the development of a Holistic perspective among students towards life and profession based on right understanding of the Human reality, family, society and the rest of nature. Such holistic perspective forms the basis of Universal Human Values (UHV) and movement towards value-based living in a natural way.
3. highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
4. aid the students to realize their full human potential and act accordingly.
5. assist the students to live with feeling of relationship, harmony and co-existence.

**UNIT I INTRODUCTION TO VALUE EDUCATION 9 hours**

Lecture 1: Understanding Value Education
Lecture 2: self-exploration as the Process for Value Education
Tutorial 1: Practice Session PS1 - Sharing about Oneself
Lecture 3: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)
Lecture 4: Continuous Happiness and Prosperity – the Basic Human Aspirations
Tutorial 2: Practice Session PS2 - Exploring Human Consciousness
Lecture 5: Happiness and Prosperity – Current Scenario
Lecture 6: Method to Fulfill the Basic Human Aspirations
Tutorial 3: Practice Session PS3 - Exploring Natural Acceptance

**UNIT II HARMONY IN THE HUMAN BEING 9 hours**

Lecture 7: Understanding Human being as the Co-existence of the self and the body.
Lecture 8: Distinguishing between the Needs of the self and the body
Tutorial 4: Practice Session PS4 - Exploring the difference of Needs of self and body.
Lecture 9: The body as an Instrument of the self
Lecture 10: Understanding Harmony in the self
Tutorial 5: Practice Session PS5 - Exploring Sources of Imagination in the self
Lecture 11: Harmony of the self with the body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS6 - Exploring Harmony of self with the body

**UNIT III HARMONY IN THE FAMILY AND SOCIETY** **9 hours**

Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS7 - Exploring the Feeling of Trust
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session PS8 - Exploring the Feeling of Respect
Lecture 16: Other Feelings, Justice in Human-to-Human Relationship
Lecture 17: Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session PS9 - Exploring Systems to fulfil Human Goal

**UNIT IV HARMONY IN THE NATURE/EXISTENCE** **9 hours**

Lecture 19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature
Tutorial 10: Practice Session PS10 - Exploring the Four Orders of Nature
Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session PS11 - Exploring Co-existence in Existence.

**UNIT V IMPLICATIONS OF THE HOLISTIC UNDERSTANDING – A LOOK AT PROFESSIONAL ETHICS** **9 hours**

Lecture 23: Natural Acceptance of Human Values
Lecture 24: Definitiveness of (Ethical) Human Conduct
Tutorial 12: Practice Session PS12 - Exploring Ethical Human Conduct
Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture 26: Competence in Professional Ethics
Tutorial 13: Practice Session PS13 - Exploring Humanistic Models in Education
Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies
Lecture 28: Strategies for Transition towards Value-based Life and Profession
Tutorial 14: Practice Session PS14 - Exploring Steps of Transition towards Universal Human Order

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

CO1: Understand the Natural Acceptance and basic human aspiration.
CO2: Aware of themselves and self-regulation.
CO3: Recognize human-human relationship (Justice) and identify human goals in the society.
CO4: Appreciate the harmony in the nature and existence.
CO5: Develop as socially and ecologically responsible engineers in handling problems with sustainable solutions (user-friendly and eco-friendly).

**Text Books:**

**1.** R R Gaur, R Asthana, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
**2.** R R Gaur, R Asthana, G P Bagaria,Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

**Reference Books:**


1. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)


**Online Learning Resources**


1. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201-Introduction%20to%20Value%20Education.pdf
2. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf
3. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf
4. https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3-S2%20Respect%20July%2023.pdf
5. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf
6. https://fdp-si.aicte-india.org/download/FDPTeachingMaterial/3-days%20FDP-SI%20UHV%20Teaching%20Material/Day%203%20Handouts/UHV%203D%20D3-S2A%20Und%20Nature-Existence.pdf
7. https://fdp-si.aicte-india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%2023-25%20Ethics%20v1.pdf
8. https://www.studocu.com/in/document/kiet-group-of-institutions/universal-human-values/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385
9. https://onlinecourses.swayam2.ac.in/aic22_ge23/preview
10. https://uhv.org.in/

11. https://www.youtube.com/@UniversalHumanValues/playlists
12. https://fdp-si.aicte-india.org/index.php

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**B. Tech II Year I Semester**

## 23MAT105 NUMERICAL METHODS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Prerequisite: 23MAT101 & 23MAT102**

**Course Description:**

This course reviews and continues the study of computational techniques for solving system of algebraic and transcendental equations, interpolating the polynomials, evaluating the derivatives, integrals, ordinary differential equations and curve fitting. The course emphasizes on numerical and mathematical methods of solutions.

**Course Objectives:**

This course enables students to

1. To introduce computation methods of solving algebraic and transcendental equations.
2. To familiarize the knowledge of interpolation.
3. To avail the basics of numerical techniques in calculus
4. To use numerical methods for solving ordinary differential equations.
5. To introduce the empirical techniques for fitting the various curves.

**UNIT I SOLUTIONS OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS 9 hours**

Introduction – Errors - Sources of errors - Bisection method - Regula-falsi method – Secant Method - Iterative method - Newton Raphson method

**UNIT II FINITE DIFFERENCES AND INTERPOLATION 9 hours**

Finite differences, Newton's forward and backward interpolation formulae - Gauss forward and backward formulae, Stirling's formula, Bessel's formula - Lagrange's and Newton's divided difference formulae

**UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 9 hours**

Formulae for derivatives, Maxima and minima of a tabulated function. Numerical Integration: Trapezoidal rule - Simpson's 1/3 Rule - Simpson's 3/8 Rule

**UNIT IV NUMERICAL SOLUTIONS TO ORDINARY DIFFERENTIAL EQUATIONS 9 hours**

Picard's Method - Taylor's series method - Euler's method - Modified Euler's Method - Runge-Kutta Method.

**UNIT V CURVE FITTING 9 hours**

Introduction - Graphical method - Principle of least squares - Method of least squares - Fitting of straight line and parabola - Fitting of exponential and power curves.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

CO1: Solve the system of algebraic and transcendental equations.
CO2: Interpolate the equal and unequal spaced arguments of function.
CO3: Apply the numerical techniques to find derivatives and integrals in the field of Engineering
CO4: Find the approximate numerical solutions to ordinary differential equations representing some Engineering problems.
CO5: Estimate the model parameters using the principles of least squares to a curve of best fit for the experimental observations.

**Text Books:**

**1.** B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 42th Edition, 2012.

**Reference Books:**

**1.** Curtis F. Gerald, Patrich O. Wheatley, Applied Numerical Analysis, Pearson Education, $7^{th}$ Edition, 2003.
**2.** S.S. Sastry, Introductory methods of numerical analysis, PHI, $4^{th}$ Edition, 2005
**3.** Burden and Faires, Numerical Analysis $7^{th}$ edition, Thomson Learning, 2001.
**4.** E. Kreyszig, Advanced Engineering Mathematics, $10^{th}$ edition, Wiley, 2010.
**5.** M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering, New Age International Ltd., $5^{th}$ Edition, 2010.
**6.** Steven C. Chapra, Applied Numerical Methods with MATLAB for Engineers and Scientists $3^{rd}$ edition, Mc Graw Hill, 2012.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**B.Tech. II Year I Semester**

## 23ME103 THERMODYNAMICS

| L | T | P | C |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

**Pre-requisite: Nil**

**Course Description:**
Thermodynamics is one of the fundamental courses in the study of mechanical engineering. The principles of thermodynamics are applicable to a wide range of problems encountered in all branches of engineering. Also, thermodynamics is an essential pre-requisite for subsequent courses in mechanical engineering like fluid mechanics, applied thermodynamics, heat transfer, gas dynamics, refrigeration and air conditioning, etc. This course is designed to equip the students with a thorough understanding of basic concepts of thermodynamics and with necessary skills and techniques to solve problems in thermodynamics through a systematic analysis using fundamental principles. The specific topics to be covered in the course include concepts of system and surroundings, energy, energy transfer by work and heat, properties of substances and property changes, first and second laws of thermodynamics.

**Course Objectives:**
1. To familiarize concepts of heat, work, energy and governing rules for conversion of one form to another.
2. To explain relationships between properties of matter and basic laws of thermodynamics.
3. To teach the concept of entropy for identifying the disorder and feasibility of a thermodynamic process.
4. To introduce the concept of available energy for maximum work conversion.
5. To provide fundamental concepts of Refrigeration and Psychrometry.

**UNIT I BASIC CONCEPTS AND FIRST LAW 9 hours**

Basic concepts — concept of continuum, microscopic and macroscopic approach. Path and point functions. Intensive and extensive, total and specific quantities. System and their types. Thermodynamic Equilibrium State, path and process. Quasi-static, reversible and irreversible processes. Heat and work transfer. Displacement work and other modes of work. P-V diagram. Zeroth law of thermodynamics — concept of temperature and thermal equilibrium– relationship between temperature scales. First law of thermodynamics –application to closed and open systems — steady and unsteady flow processes.

**UNIT II SECOND LAW AND AVAILABILITY ANALYSIS 9 hours**

Heat Reservoir, source and sink. Heat Engine, Refrigerator, Heat pump. Statements of second law and its corollaries, PMM-II. Carnot cycle, Reversed Carnot cycle, Performance. Clausius inequality. Concept of entropy, T-s diagram, Tds Equations, entropy change for — pure substance, ideal gases — different processes, principle of increase in entropy. Applications of II Law. Availability and irreversibility. Expressions for the energy of a closed system and open systems. Energy balance and entropy generation. 1$^{st}$ Law and 2$^{nd}$ Law Efficiency.

**UNIT III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE 9 hours**

Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of I and II law for pure substances. Ideal and actual Rankine cycles, Cycle Improvement Methods — Reheat and Regenerative cycles, Economiser, preheater, Binary and Combined cycles.

**UNIT IV IDEAL AND REAL GASES, THERMODYNAMIC RELATIONS 9 hours**

Properties of Ideal gas- Ideal and real gas comparison- Equations of state for ideal and real gases- Reduced properties. Compressibility factor. Principle of Corresponding states. -Generalised Compressibility Chart and its use. Maxwell relations, Tds Equations, Difference and ratio of heat capacities, Energy equation, Joule-Thomson Coefficient, Clausius Clapeyron equation, Phase Change Processes.

**UNIT V GAS MIXTURES AND PSYCHROMETRY 9 hours**

Mole and Mass fraction, Dalton's and Amagat's Law. Properties of gas mixture — Molar mass, gas constant, density, change in internal energy, enthalpy, entropy and Gibbs function. Reactive Gas Mixtures. Psychrometric properties, Psychrometric charts. Property calculations of air vapour mixtures by using chart and expressions. Psychrometric process — adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Applications.

**Course Outcomes:**

On successful completion of the course, the student will be able to:

CO1: Understand the zeroth and first law of thermodynamics by formulating temperature scales and calculating the property changes in closed and open engineering systems.

CO2: Examine the second law of thermodynamics to evaluate the efficiency of thermal devices by calculating energy and entropy.

CO3: Apply the second law of thermodynamics in evaluating the various properties of steam through steam tables and Mollier chart.

CO4: Evaluate the properties of pure substance in computing the macroscopic properties of ideal and real gases using gas laws and appropriate thermodynamic relations.

CO5: Apply the properties of gas mixtures in calculating the properties of gas mixtures and various thermodynamic relations to calculate property changes.

**Text Books:**

1. PK Nag, Engineering Thermodynamics, 6th Edition, 2017, McGraw Hill Education, ISBN: 978-9352606429
2. Çengel, Y. A., Boles, M. A., & Kanoglu, M. (2023). Thermodynamics: An engineering approach (10th ed.). McGraw-Hill Education. ISBN: 978-1266152115.

**References:**

1. J.B. Jones, and R.E. Dugan, Engineering Thermodynamics, 2/e, Prentice Hall, 1996
2. Claus Borgnakke Richard E. Sonntag, Fundamentals of Thermodynamics, 10/e, Wiley, 2022.
3. P.Chattopadhyay, Engineering Thermodynamics, 1/e, Oxford University Press, 2011.
4. CP Arora, Refrigeration and Air-conditioning, 4/e, McGraw Hill, 2021.

**Online Learning Resources:**

- https://www.edx.org/learn/thermodynamics.
- https://archive.nptel.ac.in/courses/112/106/112106310.
- https://www.coursera.org/learn/thermodynamics-intro

**Mode of Evaluation:** Assignments, Mid Term Tests, End Semester Examinati

**B.Tech. II Year I Semester**

## 23ME104 MECHANICS OF SOLIDS

| L | T | P | C |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

**Pre-requisite:** 23ME102

**Course Description:**
This course is intended to make the students learn about different types of loads acting on solid materials, thereby understanding the behaviour of the materials under such a variety of loads. This course equips the students to learn the principles and methods for analysing the stresses, strains, deformations induced in the materials under loading, and thereby to know about the failure conditions of the solid materials.

**Course Objectives:**
The objectives of the course are to

1. Understand the behaviour of basic structural members subjected to uni-axial and bi-axial loads. Students attain a deeper understanding of the loads, stresses, and strains acting on a structure and their relations in the elastic behaviour.
2. Able to analyse beams and draw complete shear and bending moment diagrams for beams.
3. Apply the concept of stress and strain to analyse and design structural members and machine parts under axial, shear and bending loads, moment and torsional moment.
4. Students will learn all the methods to analyse beams, columns, frames for normal, shear, and torsion stresses and to solve deflection problems in preparation for the design of such structural components.
5. Design and analysis of Industrial components like pressure vessels.

**UNIT I SIMPLE STRESSES & STRAINS** **9 hours**

Elasticity and plasticity – Types of stresses & strains–Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Bars of varying section – composite bars – Temperature stresses- Complex Stresses - Stresses on an inclined plane under different uniaxial and biaxial stress conditions - Principal planes and principal stresses - Mohr's circle - Relation between elastic constants, Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

**UNIT II SHEAR FORCE AND BENDING MOMENT DIAGRAMS** **9 hours**

Definition of beam – Types of beams –Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, u.d.l, uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of beam.

**UNIT III FLEXURAL STRESS & SHEAR STRESS** **9 hours**

**FLEXURAL STRESS :** Theory of simple bending, Derivation of bending equation, Determination of bending stresses – section modulus of rectangular, circular, I and T sections– Design of simple beam sections.

**SHEAR STRESS:** Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I and T sections.

**UNIT IV DEFLECTION OF BEAMS & TORSION 9 hours**

**DEFLECTION OF BEAMS:** Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, UDL and UVL. Mohr's theorem and Moment area method – application to simple cases.

**TORSION:** Introduction-Derivation- Torsion of Circular shafts- Pure Shear-Transmission of power by circular shafts, Shafts in series, Shafts in parallel.

**UNIT V THICK & THIN CYLINDERS AND COLUMNS 9 hours**

**THIN & THICK CYLINDERS:** Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and volumetric strains – changes in dia, and volume of thin cylinders– Thin spherical shells. Wire wound thin cylinders. Lame's equation – cylinders subjected to inside & outside pressures –compound cylinders.

**COLUMNS:**

Buckling and Stability, Columns with Pinned ends, Columns with other support Conditions, Limitations of Euler's Formula, Rankine's Formula

**Course Outcomes:**

On successful completion of the course, the student will be able to:

CO1: Estimate the fundamental stresses, strains, and principal stresses by analytical and Mohr's circle.

CO2: Analyze the distribution of shear force and bending moment for various types of beams under different load conditions.

CO3: Determine the flexural and shear stress and its distribution across various beams sections like rectangular, circular, triangular, I and T sections.

CO4: Evaluate bending stresses in beams and calculate the deflection and slope of beams with different types of loads.

CO5: Calculate longitudinal and circumferential stresses of pressure vessels and analyze the elastic stability of flexible columns.

**Text Books:**

1. Strength of Materials by R.K. Bansal, Rainbow Book Distributors, 6th Edition, 2020.
2. Strength of Materials by S. Ramamrutham, Dhanpat Rai Publishers, 16th Edition ,2020

**References:**

1. Mechanics of Materials by Ferdinand P. Beer and E.Russel Johnston, McGraw Hill Education (India) publicationsEdition,8e,2020
2. Mechanics of Materials by Gere and Timoshenko, C B S Publishers & Distributors, 2nd Edition, 2004.
3. Strength of Materials by R.K. Rajput, S.Chand& Company, 5th Edition,2018.
4. Strength of Materials by Dr. Sadhu Singh, Khanna Publishers, 10th Edition,2013.
5. Mechanics of solids and structures by Dr. R. Vidyanathan and Dr. P. Perumal, Laxmi Publishers.1e, 2018.

**Mode of Evaluation:** Assignments, Mid Term Tests, End Semester Examination

**B. Tech II Year I Semester**

## 23ME105 MATERIALS SCIENCE AND ENGINEERING

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite** Nil

**Course Description:**

The purpose of this course is to introduce the student to enrich their knowledge of the materials science field. Begin with the microscopic level the structure at the atomic and their impact on the material properties are discussed. The relation between heat treatment, phases and alloying elements properties of materials is also highlighted. The course mainly discusses about the different types of testing methods for materials. The final part of the course covers non-metallic materials such as ceramics and polymers.

**Course Objectives:**

1. To understand the stability of phases in various alloy systems and to comprehend the crystalline structure of various metals.
2. To study the properties of alloys and metals, both ferrous and nonferrous, and their uses in various fields
3. To know the impact of alloying element addition and heat treatment on the characteristics of ferrous metals.
4. To understand how to make metal powders and the uses of powder metallurgy.
5. To realize the functions and characteristics of composites, ceramics, and other cutting-edge techniques.

### UNIT I STRUCTURE OF METALS AND EQUILIBRIUM DIAGRAMS — 9 hours

**Structure of Metals and Constitution of alloys:** Crystallization of metals, Packing Factor - SC, BCC, FCC & HCP- line density, plane density. Grain and grain boundaries, effect of grain boundaries – determination of grain size. Imperfections, Slip and Twinning. Necessity of alloying, Types of solid solutions - Hume-Rothery rule.

**Equilibrium Diagrams:** Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of binary phase diagrams such as Cu-Ni and Fe-$Fe_3C$, Lever rule. Simple numerical problems.

**UNIT II FERROUS AND NON-FERROUS METALS AND ITS ALLOYS** **9 hours**

**Ferrous metals and alloys:** Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheroidal graphite cast iron, Alloy cast iron. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.
**Non-ferrous Metals and Alloys:** Structure and properties of copper and its alloys, aluminium and its alloys, Titanium and its alloys, Magnesium and its alloys, Super alloys.

**UNIT III HEAT TREATMENT OF STEELS** **9 hours**

Effect of alloying elements on Fe-$Fe_3C$ system, annealing, normalizing, hardening, TTT diagrams, tempering, hardenability, surface - hardening methods, age hardening treatment, Cryogenic treatment. Introduction to surface coating (PVD, CVD).

**UNIT IV POWDER METALLURGY** **9 hours**

Basic processes- Methods of producing metal powders- milling atomization- Granulation-Reduction-Electrolytic Deposition. Compacting methods – Sintering - Methods of manufacturing sintered parts. Secondary operations, Applications of powder metallurgical products.

**UNIT V ADVANCED MATERIALS** **9 hours**

Crystalline ceramics, glasses, cermet, abrasive materials, Classification of composites, manufacturing methods, particle reinforced composites, fibre-reinforced composites, PMC, MMC, CMC and CCCs. Introduction to Nanomaterials, smart materials and Bio-materials - applications.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

CO1: Understand the crystalline structure of different metals and study the stability of phases in different alloy systems by equilibrium diagrams.
CO2: Study the behaviour of ferrous and nonferrous metals and alloys and their application in different domains
CO3: Understand the effect of heat treatment and addition of alloying elements on properties of ferrous metals.
CO4: Apply the different methods of making metal powders and its applications in powder metallurgy.
CO5: Comprehend the properties and applications of ceramic, composites and other advanced methods

**Text Books:**

1. Callister, William D., Jr., and David G. Rethwisch. *Materials Science and Engineering: An Introduction*. 10th ed., Wiley, 2018.
2. S.H.Avner, Introduction to Physical Metallurgy, 2/e, Tata McGraw- Hill, 2017.

**Reference Books:**

1. Kodgire, V. D., and S. V. Kodgire. *Material Science and Metallurgy for Engineers*. 46th ed., Everest Publishing House, 2021.
2 V.Raghavan, Material Science and Engineering, 6/e, Prentice Hall of India, 2015.
3 Donald R.Askeland, Essentials of Materials science and Engineering, 4/e, CL Engineering publications, 2018.
4. George E.Dieter, Mechanical Metallurgy, 3/e, McGraw-Hill, 2017.
5. Yip-Wah Chung, Introduction to Material Science and Engineering, 2/e, CRC Press, 2022.

**Mode of Evaluation:** Assignments, Mid Term Tests, End Semester Examination.

**B. Tech II Year I Semester**

**23ME203 MECHANICS OF SOLIDS AND MATERIALS SCIENCE LABORATORY**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Course Description:**

The course is about to expose the students to a broad knowledge of experimental and analyzing techniques useful in Mechanics of solids as well as in Materials engineering field. The subject introduces the correlation of properties of various materials and their structure. It revises student's knowledge of crystal structure and phase diagrams of various alloy systems. This laboratory course offers practical knowledge of heat treatment applicable to ferrous materials and studies microstructural changes and hardness evaluation.

**Course Objectives:**

1. To perform and determine the mechanical properties of various materials.
2. To prepare samples for micro-structural examination
3. To study the microstructures of various materials under heat treatment

**List of Experiments:**

**A) MECHANICS OF SOLIDS EXPERIMENTS:**

1. Tensile test
2. Bending test on
   a) Simply supported beam
   b) Cantilever beam
3. Torsion test
4. Hardness test
   a) Rockwell hardness test
   b) Vickers hardness test
5. Impact test
   a) Charpy test
   b) Izod test
6. Double shear test

**B) MATERIALS SCIENCE EXPERIMENTS:**

1. Specimen preparation for micro-structural examination – Cutting, Grinding, Polishing, Etching.
2. Preparation and study of the Microstructure of Mild steel, medium carbon steels, and High carbon steels.
3. Study of the Microstructures of Cast Irons.
4. Study of the Microstructures of Non-Ferrous alloys.
5. Study of the Microstructures of Heat-treated steels.
6. Hardenability of steels by Jominy End Quench Test.

**Virtual lab experiments:**

1. To investigate the principal stresses σa and σb at any given point of a structural element or machine component when it is in a state of plane stress. (https://virtual-labs.github.io/exp-rockwell-hardness-experiment-iiith/objective.html)
2. To find the impact resistance of mild steel and cast iron.(https://sm-nitk.vlabs.ac.in/exp/izod-impact-test).
3. To find the impact resistance of mild steel. (https://sm-nitk.vlabs.ac.in/exp/charpy-impact-test/index.html)
4. To find the Rockwell hardness number of mild steel, cast iron, brass, aluminum and spring steel, etc. (https://sm-nitk.vlabs.ac.in/exp/rockwell-hardness-test)
5. To determine the indentation hardness of mild steel, brass, aluminum etc. using Vickers hardness testing machine. (https://sm-nitk.vlabs.ac.in/exp/vickers-hardness-test).

**Course Outcomes:**

After completion of the course students will be able to

CO1: Understand the stress strain behavior of different materials.

CO2: Evaluate the mechanical properties of different materials.

CO3: Explain the relation between elastic constants of materials.

CO4: Identify various microstructures of steels and cast irons.

CO5: Measure the hardenability of steels.

**Text Book:** Lab manual provided by the department

**Reference Books:**

1. Brandon D. G, "Modern Techniques in Metallography", Von Nostrand Inc. NJ, USA, 1986.

2. Prabhudev. K. H. "Handbook of Heat Treatment of Steels", Tata McGraw-Hill Publishing Co., New Delhi, 1988.

3. Sydney H. Avner, "Introduction to Physical Metallurgy", Tata McGraw Hill, New Delhi, 1997.

4. William D. Callister, "Materials Science and Engineering" John Wiley and Sons, 8th Edition, 2009.

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination

**B.Tech. II Year I Semester**

**23ME204 COMPUTER AIDED MACHINE DRAWING LABORATORY**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Pre-requisite:** 23ME101

**Course Description:**

The course is about the theory and technique of two-dimensional (2D) and three-dimensional (3D) modelling utilizing appropriate software. Topics include the creation and modification of 3D geometric shapes; and rendering techniques; and use of camera light sources, texture, and surface mapping.

**Course Objectives:**

1. During the term of the course, students will learn to work within virtual 3-D space.
2. Build volumetric objects including: vertices, splines, polygons, primitive shapes and Sub Patch geometry.
3. Students will use these tools to build complex objects, and then learn the basic 3-D rendering tools and techniques.
4. The student will be able to produce 2D drawing from the 3D part geometry to assure the proper dimensioning of the parts.
5. To make the students to understand and draw assemblies of machine parts and to draw their sectional views.

**List of experiments**

1. Introduction to 2D and 3D modelling
2. Drawing of Detachable Joints: bolt and nut with different screw thread
3. Drawing of Riveted Joints for Plates
4. Drawing of Welded Joints
5. Assembly of Shaft Coupling
6. Assembly of Universal Joint
7. Assembly of Knuckle Joint
8. Assembly of Simple Eccentric
9. Assembly of Screw Jack
10. Assembly of Plummer Block
11. Assembly of Machine vice

**Course Outcomes:**

On successful completion of the course, the student will be able to:

CO1: Identify different types of bolts, nuts, welding joints screw threads, keys and fasteners.

CO2: Visualize and prepare a detail drawing of a given object.

CO3: Draw details and assembly of mechanical systems.

CO4: Read and interpret the given drawing.

CO5: Create 3-D models using any standard CAD software

**Text Books:**

1. Lab manual provided by the department
2. Machine Drawing by K.L.Narayana, P.Kannaiah and K.Venkat Reddy, New Age International Publishers, 3/e, 2014

**References:**

1. Gopalakrishnan K.R, “Machine Drawing”, Subhas Stores, 2007.
2. N.D.Bhatt, Machine Drawing, Charotar Publishers, 50/e, 2014.
3. James Barclay, Brain Griffiths, Engineering Drawing for Manufacture, Kogan Page Science, 2003.

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination

**B. Tech II Year I Semester**
**Audit Course**

## 23CHE901 ENVIRONMENTAL SCIENCE

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 0 | 0 |

**Course Objectives:**
This course enables students to

1. To make the students to get awareness of the environment.
2. To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day-to-day activities of human life
3. To save the earth from the inventions by the engineers.

### UNIT I MULTIDISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES 6 hours

Definition, Scope, and Importance – Need for Public Awareness.
**Natural Resources:** Energy resources**-** Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

### UNIT II ECOSYSTEMS 7 hours

Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem:

a) Forest ecosystem.
b) Grassland ecosystem
c) Desert ecosystem.
d) Aquatic ecosystems (freshwater - ponds, streams, lakes, rivers, marine ecosystem- oceans, estuaries)

**Biodiversity and its Conservation :** Introduction, Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Specific case studies.

### UNIT III ORDERED STRUCTURES 6 hours

Definition, Cause, effects, and control measures of:
Air Pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, nuclear hazards
Pollution case studies - Role of an individual in the prevention of pollution

**Solid Waste Management:** Causes**,** effects and control measures of urban and industrial wastes
**Disaster management**: floods, earthquakes, cyclones and landslides.

**UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 5 hours**

Sustainable Development Goals, From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rainwater harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents, and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and Control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

**UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6 hours**

Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of Information Technology in Environment and human health – Case studies.

**Field Work:** Visit a local area to document environmental assets River/forest grassland/hill/mountain – Polluted site - Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

CO1: Exploring different types of renewable and non-renewable energy sources.

CO2: Students will learn about the structure and function of different ecosystems.
CO3: Students will learn about different types of pollution (air, water, soil) and their sources, effects, and control measures.
CO4: Exploring the science behind climate change, its evidence, and its impacts on ecosystems and human societies.
CO5: Understanding demographic factors and their environmental implications.

**Text Books:**


1. Textbook of Environmental Studies for Undergraduate Courses Erach Bharucha for University Grants Commission, Universities Press, Third Edition, 2021.
2. Palaniswamy, “Environmental Studies”, Pearson Education, Second Edition, 2014.
3. S. Azeem Unnisa, “Environmental Studies” Academic Publishing Company
4. K. Raghavan Nambiar, “Textbook of Environmental Studies for Undergraduate Courses as per UGC model syllabus”, Scitech Publications (India), Pvt. Ltd. Second Edition, 2008.
5. A. Koushik & C. P. Koushik, Perspectives in Environmental Studies, New Age International, Fourth Edition, 2006.

**Reference Books:**


1. Deeksha Dave and E. Sai Baba Reddy, “Textbook of Environmental Science”, Cengage Publications, Second Edition, 2012.
2. M. Anji Reddy, “Textbook of Environmental Sciences and Technology”, BS Publication, Second Edition, 2023.
3. J.P. Sharma, Comprehensive Environmental studies, Laxmi publications, Third Edition, 2009.
4. J. Glynn Henry and Gary W. Heinke, “Environmental Sciences and Engineering”, Prentice Hall of India Private Limited, Second Edition, 2004.
5. G.R. Chatwal, “A Text Book of Environmental Studies” Himalaya Publishing House, Fourth Edition, 2014.
6. Gilbert M. Masters and Wendell P. Ela, “Introduction to Environmental Engineering and Science, Prentice Hall of India Private Limited, Third Edition, 2007.


**Online Resources:**


1. Atika Qazi; Fayaz Hussain; Nasrudin ABD. Rahim; Glenn Hardaker; Daniyal Alghazzaw, "Towards sustainable energy: a systematic review of renewable energy sources, technologies, and public opinions," 10.1109/ACCESS.2019.2906402, IEEE Access, vol. 7, pp. 63837-63851, 2019.
2. Gina Garland, Samiran Banerjee, Anna Edlinger, Emily Miranda Oliveira, Chantal Herzog, Raphaël Wittwer, Laurent Philippot, Fernando T. Maestre, Marcel G. A. van der Heijden, "A closer look at the functions behind ecosystem multifunctionality: A review," https://doi.org/10.1111/1365-2745.13511, Journal of Ecology, vol. 109, no. 2, pp. 600-613, 2021.
3. Siddiqua, A, Hahladakis, J.N. and Al-Attiya, “An overview of the environmental pollution and health effects associated with waste landfilling and open dumping,” https://doi.org/10.1007/s11356-022-21578-z, Environmental Science and Pollution Research, 29(39), pp.58514-58536, 2022.
4. Seddon N, Chausson A, Berry P, Girardin C.A, Smith A. and Turner B, “Understanding the value and limits of nature-based solutions to climate change and other global challenges,” https://doi.org/10.1098/rstb.2019.0120, Philosophical Transactions of the Royal Society B, 375(1794), p.20190120, 2020.
5. Hannes Weber and Jennifer Dabbs Sciubba, "The effect of population growth on the environment: evidence from European regions," https://doi.org/10.1007/s10680-018-9486-0, European Journal of Population, vol. 35, pp. 379-402, 2019.


**Mode of Evaluation:** Assignments and Mid Term Tests

# II Year II Semester

**B. Tech II Year II Semester**

**23HUM102 ECONOMICS AND FINANCIAL ACCOUNTING FOR ENGINEERS**

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 0 | 2 |

**Course Prerequisite:** Nil

**Course Description:**

The Engineering Economics and Financial Accounting aims to provide an insight into production, cost analysis, market structure, Accounting Basic concepts and financial Statement Analysis. The course is designed to give emphasis on the application of real life examples on various fundamental issues of economics and accounts. This course introduces the accounting system, principles, types of accounts, and financial statements etc. The ratio analysis and financial analysis are useful to know the positions of financial statements are explained to know the analysis of financial matters.

**Course Objectives:**

This course enables students to

**1.** Describe the nature of engineering economics in dealing with the issues of scarcity;

**2.** Know the supply, demand, production and cost analysis to analyze the impact of economic events on markets;

**3.** Explain the different market structures and price determination in various market conditions.

**4.** Explain the accounting principles, types of accounting and preparation of final accounts; and

**5.** Describe the financial statement analysis and investment evaluation through ratios and capital budgeting techniques.

**UNIT I DEMAND ANALYSIS** **6 hours**

Scope and Significance of Economics- Elements of market Economy: Demand, Supply and Market Equilibrium- Theory of Demand, Elasticity of Demand, Supply and Law of Supply.

**UNIT II PRODUCTION AND COST ANALYSIS** **6 hours**

Production Function – Short-run and long-run production – Cost Analysis: Cost concepts - Cost Structure of Firms and Output Decision- Break-Even Analysis (BEA) – significance and Limitations of BEA - Determination of Break Even Point (Simple Problems).

**UNIT III MARKET STRUCTURE AND PRICING** **6 hours**

Classification of Markets - General Equilibrium and efficiency of Perfect competition, Monopoly, Monopolistic – Price determination under Perfect, Monopoly, and Monopolistic Competition, Pricing objectives- Pricing Strategies.

**UNIT IV BASICS OF ACCOUNTING** **6 hours**

Accounting - Double Entry System - Accounting Principles - Classification of Accounts - Rules of Debit & Credit- Accounting Cycle: Journal, Ledger, Trial Balance. Final Accounts: Trading Account - Profit & Loss Account - Balance Sheet with Adjustments, (Simple Problems).

**UNIT V FINANCIAL RATIO ANALYSIS AND CAPITAL BUDGETING 6 hours**

Ratio Analysis - Liquidity, Solvency, Activity and Profitability Ratios - Capital Budgeting. (Simple Problems).

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

CO1: Understand Engineering economics basic concepts,

CO2: Analyze the concepts of demand, elasticity, supply, Production, Cost Analysis and its essence in floating of an organization,

CO3: Compare various different market structures and identify suitable market,

CO4: Demonstrate an understanding and analyzing the accounting statements, and

CO5: Exhibit the ability to apply knowledge of ratio analysis and capital budgeting techniques in financial statement analysis and investment evaluation respectively.

**Text Books:**


1. Case E. Karl & Ray C. Fair, "Principles of Economics", Pearson Education, 8th Edition, 2007
2. Aryasri: Business Economics and Financial Analysis, 4/e. MGH.
3. Financial Accounting, S. N. Maheshwari, Sultan Chand, 2009
4. Varshney & Maheswari: Management Economics, Sultan Chand
5. Financial Statement Analysis, Khan and Jain, PHI, 2009
6. Financial Management, Prasanna Chandra, T.M.H, 2009


**Reference Books:**


1. Lipsey, R. G. & K. A. Chrystal , "Economics", Oxford University Press, 11th Edition, 2007
2. Samuelson P. A. & Nordhaus W. D. "Economics", Tata McGraw-Hill 18th Edition, 2007
3. Financial Management and Policy, Van Horne, James, C., Pearson, 2009.
4. Financial Management, I. M. Pandey, Vikas Publications


**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**B. Tech II Year II Semester**

**23MAT103 PROBABILITY AND STATISTICS FOR ENGINEERS**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Course Prerequisite: 23MAT101, 23MAT102**

**Course Description:**

This course provides an introduction to probability, distributions and statistics with applications. Topics include: Conditional probability, Random variables, Probability distributions, Joint densities, Bayesian inference, Hypothesis testing, Confidence intervals, Correlation and linear regression.

**Course Objectives:**

This course enables students to

1. To revise the elementary concepts of probability and random variables.
2. To analyze and interpret basic summary and modeling techniques for Multi-variate data.
3. To introduce new techniques for carrying out probability calculations and identifying probability distributions.
4. To understand the foundations for statistical inference involving confidence intervals and hypothesis testing.
5. To analyze the statistical experimental designs.

**UNIT I PROBABILITY AND RANDOM VARIABLES 9 hours**

Introduction to Probability, sample space and events, Axioms of probability, theorems on probability, conditional probability, multiplication theorem and independence of events, Bayes theorem.

Random Variables - Types of Random Variables - Probability Mass Function - Probability Density Function- Distribution Function and its properties. Expectation – Properties of Expected Value - Variance - Moment generating function.

**UNIT II PROBABILITY DISTRIBUTIONS 9 hours**

**Discrete Distributions**: Bernoulli trail, Binomial distribution, Poisson approximation to the binomial distribution, Poisson distribution and Hyper geometric distribution –properties.

**Continuous Distributions**: Uniform, Exponential distribution, Gamma distribution, Normal distribution. Normal probability rule and Chebyshev's inequality

**UNIT III JOINT DISTRIBUTIONS 9 hours**

Joint Densities and Independence - Marginal Distributions (discrete & continuous)- Expectation and Covariance, Correlation, Conditional densities and Regression, Curves of Regression.

**UNIT IV HYPOTHESIS TESTING 9 hours**

Population, sampling, formulation of null hypothesis, alternative hypothesis, level of significance, types of errors and power of the test. Large Sample Tests: Test for single mean, single proportion, difference of means, difference of proportions, Confidence interval for parameters in one sample and two sample problems, t test for single mean, difference of means, test for ratio of variances.

**UNIT V ANALYSIS OF VARIANCE AND DESIGN OF EXPERIMENTS 9 hours**

Analysis of Variance: One-way and two-way classifications. Principles experimental design, Randomized Block Design (RBD) and Latin Square Design.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

CO1: Understand the probability concepts and their importance in engineering.
CO2: Apply discrete and continuous probability distributions to solve various engineering problems.
CO3: Get an idea about joint density functions, distribution functions to the random variables and analyze the multivariate problems in engineering
CO4: Perform test of hypothesis as well as calculate confidence interval for a population parameter for single sample and two sample cases.
CO5: Analyse the statistical experimental designs for various engineering problems.

**Text Books:**

**1.** J.S. Milton and J.C. Arnold, Introduction to Probability and Statistics, 4th edition, 2003 Tata McGraw-Hill Publications.
**2.** Dr.B.S.Grewal, " Higher Engineering Mathematics", Khanna Publications, 42nd Edition.

**Reference Books:**

**1.** Sheldon M. Ross: Introduction to Probability and Statistics for Engineers and Scientists, 4th Edition, Elsevier, Academic Press, 2010.
**2.** Walpole, R.E., Myers R.H., Myer S.L., Ye. K: Probability and Statistics for Engineers and Scientists, 8th ed., Pearson Education, 2008.
**3.** Johnson, R.A. Miller Freund's: Probability and Statistics, 7th Edition, PHI, 2005.
**4.** Sheldon Ross: A First Course in Probability, 6th Edition, Pearson Education, 2002.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**B.Tech. II Year II Semester**

## 23ME106 MANUFACTURING TECHNOLOGY I

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** 23CME101

**Course Description:**
Manufacturing is the creation, through one or several processing operations, of components or products from basic raw materials. The effectiveness of process selection will be based on the inter-related criterion of design parameters, material selection and process economies. The course helps the students to understand the significance and applications of various traditional and advanced metal casting, joining and forming processes. The concept of stress, strain, plain stress, plain strain and yield criteria is encompassed in the course.

**Course Objectives:**

1. To provide abreast knowledge on working principles of different metal casting processes and gating systems.
2. To acquaint the students with the working of different types of welding processes and welding defects.
3. To impart an in-depth understanding on plastic deformation of metals, cold and hot working processes, working of a rolling mill and types, extrusion processes.
4. To impart fundamental knowledge of drawing process and sheet metal processes.
5. To familiarize the students with a basic understanding high energy rate forming process and additive manufacturing process.

### UNIT I METAL CASTING PROCESS

**9 hours**

**Casting & Moulding Process:** Introduction & types of casting process.
**Patterns:** Definition, classification, materials used for pattern, various pattern allowances and their importance.
**Sand Moulding**: Types of base sand, requirement of base sand. Binder, Additive's definition, need and types; preparation of sand moulds.
**Sand casting**, principles of gating, gating ratio, function of risers & runners.
**Die casting** – Types of die casting, gravity die casting, centrifugal casting & Investment casting.
**Melting Furnaces:** Principle of cupola furnace, induction furnace, electric arc furnace.
Casting defects, their causes and remedies. Testing of cast products.

### UNIT II METAL JOINING PROCESS

**9 hours**

**Introduction:** Introduction, basic principle and classification of welding processes.
Principle, advantages, limitations and Applications of Arc welding, Gas welding, Inert gas welding (TIG & MIG), Submerged arc welding,
**Special type of welding:** Resistance welding principles, Spot welding, friction stir welding, Thermit welding, plasma arc welding and laser beam welding
**Allied processes:** Soldering, Brazing and adhesive bonding
Welding defects, Heat Affected Zone, NDT techniques for weldments inspection.
**Advanced Joining Processes:** Joining of plastics, ceramics and glass and composites.
Metal Injection Moulding Process.

## UNIT III METAL FORMING PROCESS & FORGING

**9 hours**

**Introduction of metal forming process:** Mechanical behaviour of metals in elastic and plastic deformation, stress-strain relationships, Tresca and Von-Misses yield criteria, concept of plain stress and plain strain and temperature in metal working; Hot working and cold working and annealing.

**Forging** – Introduction & classification, open die forging, impression die forging, closed die forging. Classification of forging press, Principle of mechanical press and hydraulic press. Calculation of forging load and power. Defects in forging.

## UNIT IV ROLLING, EXTRUSION & DRAWING

**9 hours**

**Rolling** – Introduction & classification, Types of rolling mills, die design and design considerations, Application of rolling, calculation of rolling forces. Defects in rolling.

**Extrusion** – Introduction & classification, backward and forward extrusion, extrusion defects, design of extrusion dies, design considerations, extrusion equipment, and application of extrusion. Defects in extrusion.

**Drawing:** Introduction, wire drawing, tube drawing, lubrication, die design for drawing, drawing defects. Application of drawing, advantages and limitations, calculation of drawing forces.

## UNIT V SHEET METAL FORMING PROCESS

**9 hours**

**Sheet Metal Forming Processes:** Introduction and classification, principle and applications of different types of sheet metal forming processes. Super plastic forming. Rubber forming. Limiting drawing ratio (LDR). Spring back effect. Forming limit criterion. Types of sheet metal forming dies and press - progressive die, compound die, combination die, working of mechanical press, hydraulic press. (Cold drawing, LASER cutting)

**High Energy Rate Forming Methods**: Principles, advantages and applications, explosive forming, electrohydraulic forming, Electromagnetic forming.

**Course Outcomes:**

On successful completion of the course, the student will be able to:

CO1: Describe manufacturing process for a given product by pattern making, design of gating systems, preparation of moulding and pouring of molten metal for casting and defects.

CO2: Explain different types of welding techniques and other joining methods.

CO3: Compare cold working and hot working processes, also elucidate the forging process.

CO4: Elucidate the rolling, extrusion and drawing process.

CO5: Depict the principle of drawing process and various sheet metal processes like blanking, piercing, forming, bending, deep drawing process.

**Text Books:**

1. S. Kalpakjian and Steven R. Schmid – 'Manufacturing Engineering and Technology' – Prentice Hall – 2023 – 8th Edition
2. G.E. Dieter, Mechanical metallurgy (SI units), Mc Graw Hill, pub., 3rd edition, 2001
3. P. N. Rao, Manufacturing Technology: Foundry, Forming and Welding, Volume1, McGraw Hill Education (India) Private Limited, 5th Edition, 2018
4. Degramo, J.T. Black, Ronald, A.K., Materials and Processes in Manufacturing, Wiley, 13rd Edition 2020.

**References:**

1. B. L. Juneja, Fundamentals of Metal Forming Processes, New age publishers; Second edition, 2018
2. Amitabha Ghosh & A.K. Malik, Manufacturing Science, - East – West press,2e 2010
3. Roy A Lindberg, Processes and Materials of Manufacture, 4th Ed. Pearson Edu. 2015.

**Mode of Evaluation:** Assignments, Mid Term Tests, End Semester Examination

**B.Tech. II Year II Semester**

## 23ME107 FLUID MECHANICS AND HYDRAULIC MACHINES

| L | T | P | C |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

**Pre-requisite:** Nil

**Course Description:**

Understanding the behaviour of fluid flow is crucial for many scientific and engineering applications. Various phenomena are related to fluid mechanics, such as atmospheric and oceanic circulation, combustion in engines, and biological processes. In this course, students are introduced to various fluid properties, concepts of fluid statics, fluid kinematics and governing equations of fluid flow derived from fundamental principles of mass and momentum conservation. The course also covers fluid flow in closed conduits and over different geometries, and also introduces the design and working principles of hydraulic turbines and pumps.

**Course Objectives:**

1. To provide a basic understanding of the properties and behaviour of fluids by means of analytical equations.
2. To develop an understanding about hydrostatic law, principle of buoyancy and stability of a floating body, and application of mass, momentum and energy equation in fluid flow.
3. To determine the losses in a flow system, flow through pipes, boundary layer flow and flow past immersed bodies.
4. Determine the force applied by a jet on stationary and moving vanes.
5. To understand the working principle of hydraulic machines: Turbines and pumps.

**UNIT I FLUID PROPERTIES AND FLUID STATICS** **9 hours**

Properties of a Fluid, Newton's law of viscosity, Surface Tension and Capillarity, Pressure, Hydrostatic law, Manometry, Hydrostatic forces acting on submerged surfaces, Buoyancy and Stability, Hydrostatic forces.

**UNIT II FLUID KINEMATICS AND DYNAMICS** **9 hours**

System and Control volume, Classification of flows, Lagrangian and Eulerian descriptions, Acceleration, Streamlines, Path lines and Streak lines, Fluid body motion, Conservation of mass, Stream function, Body and surface forces, Reynold Transport Theorem, Euler's Equation, Bernoulli's Equation, Venturimeter and Orifice meter, Application of Momentum equation on pipe bends.

**UNIT III INTERNAL AND EXTERNAL FLOW** **9 hours**

Laminar flow in ducts, Turbulent flow in ducts, Minor and Major losses, Pipe Networks, Flow over flat plate, Boundary layer equations, Displacement, Momentum and Energy thicknesses, Momentum integral technique for boundary layers.

**UNIT IV IMPACT OF JET & HYDRAULIC TURBINES** **9 hours**

Hydrodynamic force of jet striking on stationary and moving vanes, flat and curved vanes, jet impinging centrally and tangentially. Impulse and reaction turbines; Basic equation of energy transfer in rotodynamic machines, Pelton turbine: Velocity triangles, Power and Efficiency, Reaction turbines: Francis turbine and Kaplan turbine, Velocity triangles, Power and Efficiency.

**UNIT V HYDRAULIC PUMPS** **9 hours**

Working principle and main parts of a centrifugal pump; Classification of centrifugal pumps; Static and Manometric head of a centrifugal pump; Efficiencies of centrifugal pump. Main parts and working of reciprocating pump; Discharge, work done and power required to drive a reciprocating pump; Slip of a reciprocating pump.

**Course Outcomes:**

On successful completion of the course, the student will be able to:

CO1: Understand the various properties of fluids and their applications, calculate pressure using manometric principles, determine the stability of floating bodies, and evaluate hydrostatic forces on different surfaces.

CO2: Identify fluid flow patterns and apply the governing equations of mass and momentum conservation to solve fluid flow problems.

CO3: Understanding of internal and external fluid flow physics concepts and evaluating the losses in pipe flows and analysing the boundary layer thickness.

CO4: Calculate the forces acting on different vane geometries and evaluate performance parameters of hydraulic turbines.

CO5: Differentiate different pumps and calculate their performance characteristics.

**Text Books:**

1. Cengel, Y.A, Cimbala, John, M., "Fluid Mechanics, Fundamentals and Applications", McGraw Hill Education; Fourth edition (28th May, 2019).
2. B.K. Venkanna, "Fundamentals of Turbomachinery", PHI Learning Pvt Ltd, 2018

**Reference Books:**

1. R. K. Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, Ltd., 2005, Revised Ninth Edition.
2. Robert W. Fox and Alan T. Mc Donald, "Introduction to Fluid Mechanics", John Wiley & Sons Private Ltd., 2010, Eighth Edition.
3. James R. Welty, Charles E. Wicks and Robert E. Wilson, "Fundamentals of Momentum, Heat and Mass transfer", John Wiley & Sons (Asia) private limited., 2008, 5th Edition.
4. Frank M White, "Fluid Mechanics", Tata McGraw-Hill, Ninth Edition, 2022.
5. Milton Van Dyke, "An Album of Fluid Motion", Parabolic Press, Fourteenth Edition, 1982.

**Mode of Evaluation:** Assignments, Mid Term Tests, End Semester Examination

**B. Tech. II Year II Semester**

## 23ME108 THEORY OF MACHINES

| L | T | P | C |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

**Course Prerequisite: 23ME102, 23MAT102**

**Course Description:**

Course Description: The objective of this course is to understand the theory involved behind the design of a machine/mechanism. After an introduction about the structure (links, joints), degrees of freedom (DOF), inversions of kinematic chains; the commonly used mechanisms derived from the 4-bar chain are then dealt. The graphical methods for performing velocity and acceleration analyses of the constituent links of lower pair mechanisms are included. The theory of gears, kinematics of gear trains, gyroscopic motion and its application, and governors, are also studied. Cam profile synthesis corresponding to different combinations of follower motions is included and so is balancing of rotating masses in machinery. Lastly, the course gives an insight into the basic concepts of vibration analysis in mechanical systems.

**Course Objectives:**

1. To introduce basic definitions, commonly used mechanisms and their applications.
2. To understand the kinematic analysis (velocity and acceleration analysis) of lower pair mechanisms.
3. To synthesize cam profiles; and to perform balancing calculations for rotating masses.
4. To learn the theory of gearing and kinematic analysis of gear trains; and understand about the practical application of gyroscopic couple and also working of governors.
5. To learn to formulate the equation of motion and solving the same for analyzing mechanical vibrations.

**UNIT I: SIMPLE MECHANISMS** **9 hours**

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom– Grashof law; kinematic inversions of four bar chain and slider crank chains; Limit positions – Mechanical advantage- Transmission angle; Quick return mechanism, Straight line mechanism.

**UNIT II: VELOCITY & ACCELERATION ANALYSIS** **9 hours**

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centres, velocity and acceleration analysis using loop closure equations - kinematic analysis of simple mechanisms - Coriolis component of acceleration.

**UNIT III: GOVERNORS & GYROSCOPE** **9 hours**

Governors: Types of governors; force analysis of Porter and Hartnell governors. Controlling force, stability, sensitiveness, isochronism, effort and power.

Gyroscope: Vectorial representation of angular motion, gyroscopic couple. Effect of gyroscopic couple on ship, plane disc, aero plane, stability of two wheelers.

**UNIT IV: GEARS** **9 hours**

Gear Profile: Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference / undercutting-helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.

**UNIT V: ROTATING MASSES** **9 hours**

Balancing of Rotating masses: Need for balancing, balancing of single mass and several masses in different planes, using analytical and graphical methods.

Cams: Classification of cams and followers- Terminology and definitions- Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- cam profile analysis - pressure angle and undercutting.

**Course Outcomes:**

On successful completion of the course, the student will be able to:

CO1: Identify the different mechanisms and their inversions in real life applications.

CO2: Calculate the velocity and acceleration of simple mechanisms by analytical & graphical methods.

CO3: Understand the principle of working of a gyroscope and determine the range of speed of different governors

CO4: Classify gears and gear trains and computing the velocity ratio.

CO5: Determine the magnitudes and angular positions of masses for balancing and sketch the cam profiles for different follower motions.

**Text Books:**

1. S S Rattan, Theory of Machines, 5th edition, Mc Graw Hill, 2019
2. R.S. Khurmi, Theory of Machines, 14th edition, S.Chand, 2020.

**References:**

1. J.E.Shigley, Theory of Machines and Mechanisms, 4/e, Oxford, 2014
2. Sadhu Singh, Theory of Machines: Kinematics and Dynamics, 3/e, Pearson, 2011.
3. P.L.Ballaney, Theory of Machines & Mechanisms, 25/e, Khanna Publishers, Delhi, 2003.
4. Norton, R.L., Design of Machinery - An introduction to Synthesis and Analysis of Mechanisms and Machines,-3/e, McGraw Hill, New York, 2003.
5. William T. Thomson, Theory of vibration with applications, 5/e, Pearson Education, 2008.
6. F. Haidery, Dynamics of Machines, 13/e, Tech-Neo Publications, 2019.

**Mode of Evaluation:** Assignments, Mid Term Tests, End Semester Examination

**B.Tech. II Year II Semester**

**23ME205 FLUID MECHANICS AND HYDRAULIC MACHINES LABORATORY**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Pre-requisite: Fluid Mechanics and Hydraulic Machines**

**Course Description:**

It is intended that the student would learn to use different techniques to measure discharge and measure head losses through straight and bent pipes. The students will also learn the performance evaluation of Pelton Wheel, Francis and Kaplan turbine, and centrifugal and reciprocating pumps.

**Course Objectives:**

1. To determine the coefficient of discharge various flow measuring equipment
2. To determine the loss of head in a pipeline
3. To conduct the performance test of hydraulic turbines and pumps.

**LIST OF EXPERIMENTS**

**Fluid Mechanics Experiments:**

1. Verification of Bernoulli's theorem
2. Determination of Coefficient of discharge of Venturimeter
3. Determination of Coefficient of discharge of Orificemeter
4. Determination of Coefficient of discharge of Turbine flow meter.
5. Determination of friction factor for a given pipeline.
6. Determination of loss of head due to sudden enlargement and contraction in a pipeline.

**Hydraulic Machines Experiments**

1. Performance test on Pelton wheel.
2. Performance test on Francis turbine.
3. Performance test on Kaplan turbine.
4. Performance test on centrifugal pump.
5. Performance test on reciprocating pump.

**Wind Tunnel Experiments**

1. Flow visualization of different objects using wind tunnel
2. Force measurement – Lift, Drag, Side force on different objects using wind tunnel

**Course Outcomes:**

After completion of the course, students will be able to

CO1: Verify Bernoulli's theorem for incompressible fluid flows.

CO2: Determine the co-efficient of discharge of flow measuring devices like Venturimeter and Orificemeter.

CO3: Determine the co-efficient of vanes like flat and curved vanes.

CO4: Determine the loss of head in pipelines due to friction, sudden contraction, enlargement, bends and elbows.

CO5: Determine the performance and draw operating characteristic curves for Pelton wheel, Reciprocating pump, and Multi-stage Centrifugal pump. wheel, Reciprocating pump, and Multi-stage Centrifugal pump.

**Text Books:**

1. Manual provided by the department.
2. Cengel, Y.A, Cimbala, John, M., "Fluid Mechanics, Fundamentals and Applications", McGraw Hill Education; Third edition (1 July 2017)

**References:**

1. R. K. Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, Ltd., 2005
2. Robert W. Fox and Alan T. Mc Donald, "Introduction to Fluid Mechanics", John Wiley & Sons Private Ltd., 2009, 7th Edition.

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination

**B.Tech. II Year II Semester**

## 23ME206 MANUFACTURING TECHNOLOGY LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Pre-requisite: 23CME101**

**Course Description:**

Manufacturing Technology -I lab is intended for operational experience on Metal casting, Welding, Mechanical Press working and processing of Plastics. These exercises inculcate the skills to the students starting from preparing a wooden pattern to completion of a casting which also comprises different Sand testing techniques. Students will also get good skills on Welding, mechanical press working, processing of plastics & composite which will be helpful to get an employment in Industries.

**Course Objectives:**

1. To provide hands-on experience of different sand-casting processes and determine the foundry sand properties
2. To provide the experience of welding process practice.
3. To familiarize with sheet metal operations practice.
4. To impart knowledge of forging operations and its practice.
5. To introduce the plastic and composite processing techniques.

**LIST OF EXPERIMENTS**

1. METAL CASTING LAB:
   a. Pattern Design and making – for one casting drawing.
   b. Sand properties testing - Exercise - for strengths, and permeability
   c. Moulding: Melting and Casting
2. WELDING LAB:
   Arc Welding: Lap & Butt Joint
   a. Spot Welding b. TIG Welding c. MIG welding d. Brazing
3. MECHANICAL PRESS WORKING:
   a. Blanking & Piercing operation and study of simple, compound and progressive press tool.
   b. Hydraulic Press: Operation –Forming exercise.
4. FORGING:
   a. Preparation of simple forging model involving upsetting and bending operations.
5. PROCESSING OF PLASTICS & COMPOSITE:
   a. Injection Moulding b. Fabrication of Composite plate

**Course Outcomes:**

The students after completing the course will be able to:

1. Produce real time casting moulds on their own.
2. Prepare various joints by using various welding processes.
3. Perform blanking, piercing and forming operations on the sheet metal.
4. Prepare a model using forging operation.
5. Prepare a specimen using injection moulding and hand lay-up process.

**Text Books:**

1. Manual provided by the department
2. S. Kalpakjian and Steven R. Schmid – 'Manufacturing Engineering and Technology' – Prentice Hall – 2013 – 7th Edition
3. P. N. Rao, Manufacturing Technology: Foundry, Forming and Welding, Volume1, McGraw Hill Education (India) Private Limited, 5th Edition, 2018

**References:**

1. B. L. Juneja, Fundamentals of Metal Forming Processes, New age publishers; Second edition, 2018
2. Roy A Lindberg, Process and Materials of Manufacturing, 4th Ed. Pearson Edu. 2006.

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination

# III Year I Semester

**B. Tech III Year I Semester**

## 23ME109 MANUFACTURING TECHNOLOGY II

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** **23ME106 MANUFACTURING TECHNOLOGY I**

**Course Objectives:**

This course is designed to:

1. Understand the fundamentals of metal cutting, chip formation, and tool life parameters.
2. Impart knowledge of conventional machine tools and perform machining time calculations.
3. Introduce various advanced machining processes with their working principles and applications.
4. Analyze the economics of machining and optimize process parameters for cost-effectiveness.
5. Introduce principles and methodologies of manufacturing process planning.

### UNIT I THEORY OF METAL CUTTING 9 hours

Overview of metal cutting, chip formation, chip thickness ratio, shear angle and its relevance, orthogonal and oblique cutting processes, types of chips, chip breakers.

Forces and energy calculations (merchant's analysis), power consumed, tool wear, tool life (Taylor's equation), tool materials, cutting fluids, numerical problems.

### UNIT II MACHINE TOOLS AND MACHINING OPERATIONS 9 hours

Introduction to machine tools and machining operations in lathe, milling, shaping, drilling, planner and grinding machines. Calculations of machining time and other process parameters on Turning, Milling, Shaping, Grinding operations.

### UNIT III ADVANCED MACHINING PROCESSES 9 hours

Introduction to advanced machining processes. Classification, working principle, applications and limitations of AJM, UM, ECM, EDM, WEDM, LBM, EBM & IBM. Hard Machining and High-Speed Machining.

### UNIT IV ECONOMICS IN MACHINING 9 hours

Resource management and economic considerations in machining, cost of single pass turning operation, optimum cutting speed in turning for minimum cost, optimum cutting speed in turning for maximum production rate & profit rate, numerical problems. Case Studies on Advanced Machining Processes.

### UNIT V MANUFACTURING PROCESS PLANNING 9 hours

Introduction to Process Planning: Role in product development and manufacturing systems, Types of Process Planning: Manual vs. Computer-Aided Process Planning (CAPP), Process Selection Criteria: Material, geometry, tolerance, surface finish, and quantity, Routing and Operation Sheets: Steps, tools, machines, and sequences, Time Estimation and Standardization: Machining time, setup time, cycle time, Tooling and Fixture Selection: Guidelines for productivity and cost-efficiency, Case Studies: Sample process plans for mechanical components.

**Course Outcomes:**

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

CO1: Explain the mechanics of metal cutting, interpret chip formation and tool life equations, and identify suitable cutting fluids and tool materials. (L2)

CO2: Calculate machining time, analyze process parameters, and apply them to conventional machines like lathe, milling, and grinding. (L3)

CO3: Describe the working principles of advanced machining processes and compare their applications and limitations. (L2)

CO4: Analyze cost and productivity factors in machining operations and determine optimum cutting parameters using economic principles. (L4)

CO5: Develop a complete process plan for a given component, including operation sequence, tooling, and time estimation. (L3)

**Text Books:**

1. Kalpakjian, S., & Schmid, S. R. (2025). Manufacturing engineering and technology (9th ed.). Pearson Education.
2. Groover, M. P. (2020). Fundamentals of modern manufacturing: Materials, processes, and systems (7th ed.). Wiley.
3. Choudhury, S. K. H., Choudhury, A. K., & Roy, N. (2023). Elements of workshop technology: Machine tools (Vol. 1, 17th ed.). Media Promoters & Publishers.

**Reference Books:**

1. Lindberg, R. A. (2018). Processes and materials of manufacture (5th ed.). Pearson Education.
2. Abellan-Nebot, J. V., Vila Pastor, C., & Siller, H. R. (2025). Manufacturing process planning: A practical approach for mechanical engineering. Wiley.
3. Rao, P. N. (2023). Manufacturing technology: Metal cutting and machine tools (4th ed.). McGraw Hill Education.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**B. Tech III Year I Semester**

## 23ME110 HEAT TRANSFER

| L | T | P | C |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

**Pre-requisite:** **23ME103 THERMODYNAMICS**

**Course Objectives:**

This course is designed to:

1. Understand the fundamental mechanisms and laws governing various modes of heat transfer.
2. Utilize numerical methods for solving one-dimensional heat transfer problems using computational tools.
3. Analyze conduction, convection, radiation, and phase change heat transfer problems in practical engineering systems.
4. Apply analytical and empirical techniques to determine heat transfer rates and thermal behavior in different geometries.
5. Examine the performance of heat exchangers and identify factors affecting their efficiency.

**UNIT I HEAT CONDUCTION** **9 hours**

Basic modes of heat transfer - generalized heat conduction equation-various forms - steady state heat conduction solution for plane and composite slabs – cylinders, spheres - critical thickness of insulation-heat conduction through fins of uniform cross section- fin effectiveness and efficiency. Transient heat conduction- lumped system analysis.

**UNIT II NUMERICAL ANALYSIS OF ONE-DIMENSIONAL HEAT TRANSFER** **9 hours**

Introduction to Numerical Methods for heat transfer: finite difference approach, 1D Steady-State Heat Conduction without and with internal heat generation, Discretization of governing equations using finite difference method (FDM), Boundary conditions: Dirichlet, Neumann, and mixed – implementation in numerical schemes, Case Studies: Implementation of computer programs / software in 1D conduction solvers.

**UNIT III HEAT CONVECTION** **9 hours**

Basic concepts of convection–heat transfer coefficients. Free and Forced Convection - Hydrodynamic and Thermal Boundary Layer. Free and Forced Convection during external flow over Plates and Cylinders and Internal flow through tubes.

**UNIT IV PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS** **9 hours**

Different regimes of boiling- nucleate, transition and film boiling – condensation – film wise and drop wise condensation-problems. Types of heat exchangers- parallel flow- counter flow- cross flow heat exchangers- overall heat transfer coefficient- LMTD and NTU methods- fouling in heat exchangers-problems

**UNIT V RADIATION HEAT TRANSFER** **9 hours**

Radiation: Radiation heat transfer – thermal radiation – laws of radiation - Black and Gray bodies, Radiosity, Radiation Intensity, Shape factor-radiation exchange between surfaces, Radiation shields

**Course Outcomes:**

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

CO1: Explain the generalized heat conduction equation and analyze steady-state and transient heat conduction in various geometries. (L3)

CO2: Implement finite difference methods for one-dimensional heat conduction problems and simulate solutions using MATLAB or Python. (L4)

CO3: Differentiate between free and forced convection and compute heat transfer coefficients for external and internal flows. (L3)

CO4: Classify the regimes of boiling and condensation, and solve problems related to different types of heat exchangers using LMTD and NTU methods. (L3)

CO5: Describe laws of thermal radiation and calculate radiation heat exchange between surfaces using shape factors and shields. (L3)

**Text Books:**

1. Cengel, Y. A., & Ghajar, A. J. (2022). Heat and mass transfer: Fundamentals and applications (7th ed.). McGraw Hill Education.
2. Incropera, F. P., DeWitt, D. P., Bergman, T. L., & Lavine, A. S. (2017). Fundamentals of heat and mass transfer (8th ed.). Wiley.
3. Nag, P. K. (2020). Heat and mass transfer (4th ed.). McGraw Hill Education.

**Reference Books:**

1. Holman, J. P. (2021). Heat transfer (11th ed.). McGraw Hill.
2. Kaviany, M. (2023). Essentials of heat transfer (2nd ed.). Cambridge University Press.
3. Yadav, R. (2022). Heat and mass transfer (Revised ed.). Central Publishing House.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**B. Tech III Year I Semester**

## 23ME111 METROLOGY AND MEASUREMENTS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** None

**Course Objectives:**

This course is designed to:

1. Introduce the fundamentals of metrology and measurement systems, including accuracy, precision, and standardization.
2. Impart knowledge on limits, fits, tolerances, and the design of gauges used in manufacturing.
3. Develop understanding of surface texture measurement, thread/gauge inspection, and the use of CMM.
4. Explain the construction and working principles of displacement, strain, and force measuring devices.
5. Familiarize students with torque, pressure, and temperature measurement techniques, including conventional and modern methods.

### UNIT I CONCEPT OF METROLOGY AND MEASUREMENTS 9 hours

**Introduction to Metrology:** Introduction, Need of inspection, Principles, process, methods of measurement, Classification and selection of measuring instruments and systems. Accuracy, precision and errors in measurement.

System of measurement, Classification of standards and Traceability, Calibration of End bars (Numerical), standardization.

**Linear Measurement:** Vernier instruments, micrometers, slip gauges, problems on building of slip gauges (M87, M112).

**Comparators:** Mechanical, pneumatic and electrical.

**Angular measurements:** Sine bar, Sine centre, bevel protractor, tool makers microscope.

**Flatness Measurement:** Measurement of flatness, surface plates, optical flat and autocollimator.

**Coordinate Measuring Machine (CMM)** - Construction and features.

### UNIT II SYSTEM OF LIMITS, FITS, TOLERANCE AND GAUGING 9 hours

Definition of tolerance, Specification in assembly, Principle of interchangeability and selective assembly, limits of size, Indian standards, concept of limits of size and tolerances, definition of fits, hole basis system, shaft basis system, types of fits and their designation (IS 919-1963), geometric dimensioning and tolerance, position-tolerances. (simple numerical on limits and fits).

Classification of gauges, brief concept of design of gauges (Taylor's principles), Wear allowance on gauges, Types of gauges and gauge materials.

### UNIT III SURFACE ROUGHNESS, SCREW THREAD AND GEAR MEASUREMENT 9 hours

**Surface Roughness Measurement:** Terminology systems, differences between surface roughness and surface waviness- Numerical assessment of surface finish - CLA, R.M.S Value-Ra, Rz values, Methods of surface roughness measurement- profilograph, Talysurf, BIS symbols for indication of surface roughness. Non-contact surface roughness measurement (Optical Interferometry).

**Screw thread measurements:** Elements of threads, errors in screw threads, various methods for measuring external and internal screw threads, screw thread gauges.

**Gear Measurement:** Gear tooth terminology, measurement of gear elements-constant chord, base tangent method. Parkinson gear roll tester for composite error.

**UNIT IV MEASUREMENT OF DISPLACEMENT AND STRAIN 9 hours**

**Measurement of Displacement:** Theory and construction of various transducers– Piezo-electric, inductive, capacitance, resistance and photoelectric transducers.

**Measurements of Strain:** Various types of electrical strain gauges, gauge factor, temperature compensation, method of usage of resistance strain gauge for bending, compressive and tensile strains, usage for measuring torque, strain gauge rosettes.

**Measurement of Force:** Direct method - analytical balance, platform balance; elastic members – load cells, cantilever beams and proving rings.

**UNIT V MEASUREMENT OF TORQUE, PRESSURE AND TEMPERATURE 9 hours**

**Measurement of Torque:** Torsion bar dynamometer, servo-controlled dynamometer and absorption dynamometer.

**Measurement of Pressure:** Basic methods of pressure measurement, dead weight gauges and manometers, Elastic transducers, Bridgeman gauge, McLeod gauge, Pirani gauge.

**Measurement of Temperature:** Resistance Temperature Detectors, Thermistors, Thermocouples, radiative measurements (pyrometers). Non-contact temperature measurement.

**Course Outcomes:**

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

CO1: Describe the fundamentals of metrology, explain the concepts of measurement systems, accuracy, and calibration, and solve numerical problems involving slip gauge combinations and standards. (L3)

CO2: Identify different fits and tolerances based on IS standards, apply Taylor's principles to gauge design, and calculate limits and allowances for assembly applications. (L3)

CO3: Explain methods of surface roughness, screw thread, and gear measurements, analyze surface profiles using Ra and Rz values, and interpret BIS symbols and CMM applications for dimensional accuracy. (L4)

CO4: Explain the working of displacement and strain measurement devices, use electrical strain gauges for various load conditions, and differentiate among transducer types for mechanical applications. (L2)

CO5: Describe the methods for measuring torque, pressure, and temperature, compare different transducers and instruments, and select suitable devices for specific industrial measurements. (L2)

**Text Books:**

1. Beckwith, T. G., Marangoni, R. D., & Lienhard, J. H. (2020). Mechanical measurements (7th ed.). Pearson Education.
2. Jain, R. K. (2022). Engineering metrology (21st ed.). Khanna Publishers.
3. Gupta, I. C. (2019). A textbook of engineering metrology. Dhanpat Rai Publishing.

**Reference Books:**

1. Raghavendra, N. V., & Krishnamurthy, L. (2019). Engineering metrology and measurements (2nd ed.). Oxford University Press.
2. Bewoor, A. K., & Kulkarni, V. A. (2018). Metrology and measurement (2nd ed.). McGraw Hill Education.
3. Kumar, D. S. (2021). Mechanical measurements and control (6th ed.). Metropolitan Book Co.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**B.Tech III Year I Semester**

## 23PHY102 INTRODUCTION TO QUANTUM TECHNOLOGIES AND APPLICATIONS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** None

**Course Objectives:**

The main objectives of the course is to

1. Introduce fundamental quantum concepts like superposition and entanglement.
2. Understand theoretical structure of qubits and quantum information.
3. Explore conceptual challenges in building quantum computers.
4. Explain principles of quantum communication and computing.
5. Examine real-world applications and the future of quantum technologies.

### UNIT I INTRODUCTION TO QUANTUM THEORY AND TECHNOLOGIES 9 hours

The transition from classical to quantum physics, Fundamental principles explained conceptually: Superposition, Entanglement, Uncertainty Principle, Wave-particle duality, Classical vs Quantum mechanics – theoretical comparison,Quantum states and measurement: nature of observation,Overview of quantum systems: electrons, photons, atoms,The concept of quantization: discrete energy levels,Why quantum? Strategic, scientific, and technological significance,A snapshot of quantum technologies: Computing, Communication, and Sensing,National and global quantum missions: India's Quantum Mission, EU, USA, China

### UNIT II THEORETICAL STRUCTURE OF QUANTUM INFORMATION SYSTEMS 9 hours

What is a qubit? Conceptual understanding using spin and polarization, Comparison: classical bits vs quantum bits, Quantum systems: trapped ions, superconducting circuits, photons (non-engineering view),Quantum coherence and decoherence – intuitive explanation, Theoretical concepts: Hilbert spaces, quantum states, operators – only interpreted in abstract,The role of entanglement and non-locality in systems, Quantum information vs classical information: principles and differences,Philosophical implications: randomness, determinism, and observer role

### UNIT III BUILDING A QUANTUM COMPUTER – THEORETICAL CHALLENGES AND REQUIREMENTS 9 hours

What is required to build a quantum computer (conceptual overview)?,Fragility of quantum systems: decoherence, noise, and control, Conditions for a functional quantum system: Isolation, Error management, Scalability, Stability, Theoretical barriers:

Why maintaining entanglement is difficult,Error correction as a theoretical necessity, Quantum hardware platforms (brief conceptual comparison),Superconducting circuits, Trapped ions, Photonics, Visionvs reality: what's working and what remains elusive,The role of quantum software in managing theoretical complexities

**UNIT IV** **QUANTUM COMMUNICATION AND COMPUTING – THEORETICAL PERSPECTIVE** **9 hours**

Quantum vs Classical Information, Basics of Quantum Communication, Quantum Key Distribution (QKD),Role of Entanglement in Communication,The Idea of the Quantum Internet – Secure Global Networking,Introduction to Quantum Computing,Quantum Parallelism (Many States at Once),Classical vs Quantum Gates, Challenges: Decoherence and Error Correction,Real-World Importance and Future Potential

**UNIT V** **APPLICATIONS, USE CASES, AND THE QUANTUM FUTURE** **9 hours**

Real-world application domains: Healthcare (drug discovery),Material science, Logistics and optimization, Quantum sensing and precision timing, Industrial case studies: IBM, Google, Microsoft, PsiQuantum,Ethical, societal, and policy considerations, Challenges to adoption: cost, skills, standardization,Emerging careers in quantum: roles, skillsets, and preparation pathways,Educational and research landscape – India's opportunity in the global quantum race

**Course Outcomes:**

CO1: Explain core quantum principles in a non-mathematical manner.
CO2: Compare classical and quantum information systems.
CO3: Identify theoretical issues in building quantum computers.
CO4: Discuss quantum communication and computing concepts.
CO5: Recognize applications, industry trends, and career paths in quantum technology.

**Text Books:**


1. Michael A. Nielsen, Isaac L. Chuang, *Quantum Computation and Quantum Information*, Cambridge University Press, 10th Anniversary Edition, 2010.
2. Eleanor Rieffel and Wolfgang Polak, *Quantum Computing: A Gentle Introduction*, MIT Press, 2011.
3. Chris Bernhardt, *Quantum Computing for Everyone*, MIT Press, 2019.


**Reference Books:**


1. David McMahon, *Quantum Computing Explained*, Wiley, 2008.
2. Phillip Kaye, Raymond Laflamme, Michele Mosca, *An Introduction to Quantum Computing*, Oxford University Press, 2007.
3. Scott Aaronson, *Quantum Computing Since Democritus*, Cambridge University Press, 2013.
4. **Alastair I.M. Rae**, *Quantum Physics: A Beginner's Guide*, Oneworld Publications, Revised Edition, 2005.
5. **Eleanor G. Rieffel, Wolfgang H. Polak**, *Quantum Computing: A Gentle Introduction*, MIT Press, 2011.
6. **Leonard Susskind, Art Friedman**, *Quantum Mechanics: The Theoretical Minimum*, Basic Books, 2014.
7. **Bruce Rosenblum, Fred Kuttner**, *Quantum Enigma: Physics Encounters Consciousness*, Oxford University Press, 2nd Edition, 2011.

8. **GiulianoBenenti, GiulioCasati, GiulianoStrini**, *Principles of Quantum Computation and Information, Volume I: Basic Concepts*, World Scientific Publishing, 2004.
9. **K.B. Whaley et al.**, *Quantum Technologies and Industrial Applications: European Roadmap and Strategy Document*, Quantum Flagship, European Commission, 2020.
10. **Department of Science & Technology (DST), Government of India**, *National Mission on Quantum Technologies & Applications – Official Reports and Whitepapers*, MeitY/DST Publications, 2020 onward.

**Online Learning Resources**:

1. IBM Quantum Experience and Qiskit Tutorials
2. Coursera – Quantum Mechanics and Quantum Computation by UC Berkeley
3. edX – The Quantum Internet and Quantum Computers
4. YouTube – Quantum Computing for the Determined by Michael Nielsen
5. Qiskit Textbook – IBM Quantum

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**B. Tech III Year I Semester**

## 23ME207 HEAT TRANSFER LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Pre-requisite: None**

**Course Objectives:**

This course is designed to:

1. Introduce the fundamental concepts of conduction, convection, and radiation through hands-on experiments.
2. Provide exposure to experimental methods for measuring thermal conductivity and heat transfer coefficients.
3. Familiarize students with various modes of heat transfer in steady and transient conditions.
4. Enhance analytical skills by comparing experimental data with theoretical predictions.
5. Develop competency in operating thermal equipment and interpreting results for practical thermal systems.

**List of Experiments:**

1. Determination of thermal conductivity of a metal rod
2. Determination of thermal conductivity of insulating powder material
3. Determination of overall heat transfer coefficient of a composite wall
4. Experiment on heat transfer through a composite cylinder
5. Determination of heat transfer coefficient for a vertical cylinder in natural convection
6. Determination of heat transfer coefficient in forced convection of air in a horizontal tube.
7. Determination of efficiency of a pin fin in natural and forced convection.
8. Determination of effectiveness of a heat exchanger in parallel and counter flow conditions.
9. Determination of heat transfer coefficients on film and drop wise condensation.
10. Determination the emissivity of a gray body.
11. Experiment on Stefan-Boltzmann apparatus.
12. Numerical analysis of 1D heat conduction using MATLAB / PYTHON.
13. Case Study on effect of heat on industrial machineries.

**Course Outcomes:**

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

CO1: Determine the thermal conductivity of solid and insulating materials using experimental data. (L3)

CO2: Evaluate heat transfer coefficients in natural and forced convection setups. (L5)

CO3: Analyze heat flow in composite structures and performance of heat exchangers. (L4)

CO4: Interpret radiation heat transfer characteristics such as emissivity and Stefan-Boltzmann law. (L2)

CO5: Develop and simulate numerical models for one-dimensional heat conduction using MATLAB or Python to understand temperature distribution in solids. (L6)

**Reference Books:**

1. Lab manual provided by the department.

**Virtual Labs:**

1. Heat Transfer Lab by NITK - https://ht-nitk.vlabs.ac.in

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination

**B. Tech III Year I Semester**

## 23ME208 MACHINE TOOLS AND METROLOGY LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Pre-requisite: None**

**Course Objectives:**

This course is designed to:

1. Familiarize students with the construction and working of general-purpose machine tools such as lathe, drilling, milling, shaping, slotting, and grinding machines.
2. Develop hands-on skills in performing basic and advanced operations on machine tools including turning, tapering, threading, slotting, and gear cutting.
3. Impart practical knowledge of measuring tools and calibration techniques used in precision metrology.
4. Enable students to carry out inspection of machine tool alignments, threads, angles, and surface finish using standard metrological instruments.
5. Bridge the gap between theoretical concepts and practical implementation in machining and metrology processes to ensure dimensional accuracy and quality control.

**List of Experiments (Machine Tools):**

1. Introduction of general-purpose machines -Lathe, Drilling machine, Milling machine, Shaper, Slotting machine, Surface grinder and Tool and cutter grinder.
2. Operations on Lathe machines- Step turning, Knurling, Taper turning, Thread cutting and Drilling
3. Operations on Drilling machine - Drilling, reaming, tapping
4. Operations on Shaping machine - Round to square
5. Operations on Slotter - Keyway cutting
6. Operations on milling machines - (i) Indexing (ii) Gear manufacturing

**List of Experiments (Metrology):**

1. Dimensional measurement of various engineering specimens using vernier calipers and micrometer.
2. Measurement of bores by internal micrometers and dial bore indicators of various engineering specimens.
3. Use of gear tooth vernier calipers for tooth thickness inspection for checking the chordal thickness of a spur gear.
4. Machine tool alignment test on the lathe.
5. Angle and taper measurements with bevel protractor and Sine bar of various engineering specimens.
6. Thread inspection with tool makers microscope.
7. Surface Roughness Measurement of various engineering specimens.

**Course Outcomes:**

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

CO1: Apply various machining operations such as turning, drilling, shaping, and milling using conventional machine tools to produce components with required dimensions and tolerances. (L3)

CO2: Analyze the suitability of different machine tool operations for specific machining tasks and select appropriate parameters for efficient machining. (L4)

CO3: Evaluate the accuracy and alignment of machine tools and machined components using calibrated instruments and precision metrological techniques. (L5)

CO4: Understand the principles of gear manufacturing and indexing in milling operations and thread inspection techniques. (L2)

CO5: Create a complete measurement report by integrating observations from various metrological tools to assess the quality and finish of machined parts. (L6)

**Reference Books:**

1. Lab manual provided by the department.

**Virtual Labs:**

1. Sensors and Instrumentation Lab by COEP technological University Pune - https://sil-coep.vlabs.ac.in
2. Instrumentation and Control Lab by COEP technological University Pune - https://ic-coep.vlabs.ac.in

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination

**B. Tech III Year I Semester**

## 23ECE501 TINKERING LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 2 | 1 |

**Course Description:**

The aim of tinkering lab for engineering students is to provide a hands-on learning environment where students can explore, experiment, and innovate by building and testing prototypes. These labs are designed to demonstrate practical skills that complement theoretical knowledge. These labs bridge the gap between academia and industry, providing students with the practical experience. Some students may also develop entrepreneurial skills, potentially leading to start-ups or innovation-driven careers. Tinkering labs aim to cultivate the next generation of engineers by giving them the tools, space, and mind-set to experiment, innovate, and solve real-world challenges.

**Course Objectives:**

1. Encourage Innovation and Creativity
2. Provide Hands-on Learning and Impart Skill Development
3. Foster Collaboration and Teamwork
4. Enable Interdisciplinary Learning, Prepare for Industry and Entrepreneurship
5. Impart Problem-Solving mind-set

**List of Experiments:**

1. Make your own parallel and series circuits using breadboard for any application of your choice.
2. Design and 3D print a Walking Robot
3. Design and 3D Print a Rocket.
4. Temperature & Humidity Monitoring System (DHT11 + LCD)
5. Water Level Detection and Alert System
6. Automatic Plant Watering System
7. Bluetooth-Based Door Lock System
8. Smart Dustbin Using Ultrasonic Sensor
9. Fire Detection and Alarm System
10. RFID-Based Attendance System
11. Voice-Controlled Devices via Google Assistant
12. Heart Rate Monitoring Using Pulse Sensor
13. Soil Moisture-Based Irrigation
14. Smart Helmet for Accident Detection
15. Milk Adulteration Detection System
16. Water Purification via Activated Carbon
17. Solar Dehydrator for Food Drying

18. Temperature-Controlled Chemical Reactor
19. Ethanol Mini-Plant Using Biomass
20. Smart Fluid Flow Control (Solenoid + pH Sensor)
21. Portable Water Quality Tester
22. AI Crop Disease Detection
23. AI-based Smart Irrigation
24. ECG Signal Acquisition and Plotting
25. AI-Powered Traffic Flow Prediction
26. Smart Grid Simulation with Load Monitoring
27. Smart Campus Indoor Navigator
28. Weather Station Prototype
29. Firefighting Robot with Sensor Guidance
30. Facial Recognition Dustbin
31. Barcode-Based Lab Inventory System
32. Growth Chamber for Plants
33. Biomedical Waste Alert System
34. Soil Classification with AI
35. Smart Railway Gate
36. Smart Bin Locator via GPS and Load Sensors
37. Algae-Based Water Purifier
38. Attendance via Face Recognition

**Note**: The students can also design and implement their own ideas, apart from the list of experiments mentioned above.

**Note**: A minimum of 8 to 10 experiments must be completed by the students.

**Course Outcomes:**

After completion of the course, Students will be able to

CO1: Apply the principles of design thinking to identify real-world problems and develop feasible solutions.

CO2: Demonstrate proficiency in using basic tools, components, and digital fabrication technologies (e.g., Arduino, sensors, 3D printing, etc.).

CO3: Develop functional prototypes through iterative design, fabrication, and testing.

CO4: Collaborate effectively in multidisciplinary teams to brainstorm, plan, and execute tinkering projects.

CO5: Document the development process, evaluate outcomes, and communicate project results clearly using oral, visual, and written formats.

**Reference Books:**

**1.** "Make: Getting Started with Arduino" by Massimo Banzi, Maker Media Publications.

**Online Resources:**

**1.** https://aim.gov.in/pdf/equipment-manual-pdf.pdf

**2.** https://atl.aim.gov.in/ATL-Equipment-Manual/

**3.** https://aim.gov.in/pdf/Level-1.pdf

**4.** https://aim.gov.in/pdf/Level-2.pdf

**5.** https://aim.gov.in/pdf/Level-3.pdf

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination

# III Year II Semester

**B. Tech III Year II Semester**

## 23ME112 THERMAL ENGINEERING

| L | T | P | C |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

**Pre-requisite:** **23ME103 Thermodynamics**

**Course Objectives:**

This course is designed to:

1. Introduce the basic concepts, classifications, and working principles of internal combustion engines and their components.
2. Provide comprehensive knowledge on fuel systems, ignition systems, and combustion phenomena in S.I. and C.I. engines.
3. Enable understanding of performance parameters and testing methods of I.C. engines, including heat balance and Morse tests.
4. Familiarize students with various types of air compressors, their efficiencies, and performance-enhancing techniques.
5. Impart fundamental concepts of nozzles and gas turbines, with emphasis on flow dynamics and thermodynamic cycles.

**UNIT I INTERNAL COMBUSTION ENGINES** **9 hours**

Definition of Engine and Heat Engine, I.C Engine Classification – Parts of I.C. Engines, Working of I.C. Engines, Two Stroke & Four Stroke I.C. Engines SI & CI Engines, Valve and Port Timing Diagrams.

**UNIT II FUELS AND COMBUSTION** **9 hours**

Overview of fuel supply systems – types of carburettors, air filters, mechanical and electrical fuel pumps, and gasoline injection systems. Ignition Systems in S.I. Engines: Function of ignition systems – battery coil, magneto, and electronic ignition. Combustion in S.I. Engines: Normal vs. abnormal combustion – flame speed, pre-ignition, and knocking. Fuel requirements, fuel rating (octane number), and anti-knock additives. Combustion in C.I. Engines: Stages of combustion, delay period, diesel knock. Fuel requirements, cetane number.

**UNIT III TESTING AND PERFORMANCE** **9 hours**

Testing and Performance: Parameters of Performance - Measurement of Cylinder Pressure, Fuel Consumption, Air Intake, Exhaust Gas Composition, Brake Power – Determination of Frictional Losses and Indicated Power – Performance Test – Heat Balance Sheet and Chart and **Morse test.**

**UNIT IV AIR COMPRESSORS** **9 hours**

Air Compressors: Reciprocating Compressors, Effect of Clearance volume in Compressors, Volumetric Efficiency, Single Stage and Multistage Compressors, Effect of Inter cooling and Pressure Drop in Multi - Stage Compressors, Problems Related to Reciprocating Compressors, Working principles of Roots blower, Vane type Blower, Centrifugal Compressor - Axial Flow Compressors.

**UNIT V NOZZLES AND GAS TURBINES** **9 hours**

Flow Through Nozzles: Types of nozzles – convergent, divergent, and convergent-divergent; isentropic flow through nozzles; effect of back pressure; critical pressure ratio; choking in nozzles. Applications in propulsion and steam turbines. Introduction to Gas Turbines: Classification and working principle of gas turbines – open and closed cycle gas turbines. Brayton cycle analysis – ideal and actual cycles. Methods to improve efficiency: intercooling, reheating, and regeneration.

**Course Outcomes:**

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

CO1: Describe and compare the construction, classification, and working principles of two-stroke and four-stroke I.C. engines using valve and port timing diagrams. (L2)

CO2: Illustrate and differentiate fuel supply and ignition systems; analyze normal and abnormal combustion processes in S.I. and C.I. engines. (L3)

CO3: Conduct performance tests on I.C. engines; calculate and interpret heat balance, frictional losses, and power output using appropriate formulas and test data. (L4)

CO4: Explain the operation of single-stage and multistage compressors; analyze the effects of clearance volume, intercooling, and pressure drops on compressor performance. (L3)

CO5: Compute nozzle flow characteristics under varying conditions; evaluate gas turbine cycles and suggest efficiency-improving techniques such as regeneration and reheating. (L4)

**Text Books:**

1. Heywood, J. B. (2018). Internal combustion engine fundamentals (2nd ed.). McGraw Hill Education.
2. Ganesan, V. (2017). Internal combustion engines (4th ed.). McGraw Hill Education.
3. Rajput, R. K. (2020). Thermal engineering (11th ed.). Laxmi Publications.

**Reference Books:**

1. Pulkrabek, W. W. (2015). Engineering fundamentals of the internal combustion engine (2nd ed.). Pearson Education.
2. Rudramoorthy, R. (2017). Thermal engineering (1st ed.). Tata McGraw Hill.
3. Mathur, M. L., & Sharma, R. P. (2017). Internal combustion engines (Revised ed.). Dhanpat Rai & Sons.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**B. Tech III Year II Semester**

**23ME113 CAD/CAM**

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite: None**

**Course Objectives:**

This course is designed to:

1. Introduce the fundamentals of CAD/CAM systems and computer graphics used in design and manufacturing.
2. Develop an understanding of geometric, surface, and solid modeling techniques using mathematical representations.
3. Familiarize students with CAM components, CNC machines, and automation elements in manufacturing systems.
4. Impart knowledge on CNC programming for turning and milling operations using ISO codes and compensation methods.
5. Expose students to advanced manufacturing systems like FMS and evolving concepts in Industry 4.0 and Industry 5.0.

**UNIT I INTRODUCTION TO CAD/ CAM & COMPUTER GRAPHICS 9 hours**

Introduction to CAD & CAM-Computer in industries- CAD/CAM hardware, computer graphics- CRT, Raster Scan, Random Scan Techniques – Advantages, limitations and applications. transformation of geometry, 3D transformations, Introduction to CAD Data Exchange Formats-IGES, ACIS, DXF and STL.

**UNIT II GEOMETRY, SURFACE AND SOLID MODELLING 9 hours**

**Geometry modelling**: Introduction, Representation of Curves – nonparametric and parametric. Synthetic Curves – Hermite Cubic spline –Bezier Curves – B-Spline Curves.

**Surface Modeling**: Introduction-Classification of surface entities, –Plane Surface –Ruled Surface, Synthetic Surfaces – Hermite Bi-cubic Surface – Bezier Surface – B – Spline Surface.

**Solid Modeling:** Introduction, Fundamentals – Geometry and topology, Boundary representation techniques – CSG techniques.

**UNIT III INTRODUCTION TO CAM 9 hours**

Introduction & History of CNC Systems, Components, Advantages, Disadvantages and Limitations.

**Machining center**- types and features, Axes Nomenclature, Feedback devices (Transducers, Encoders), Tool magazine, Automatic Tool Changers (ATC), Automatic Pallet Changer (APC), Tool-Pre-setting – Concept and Importance, Qualified Tools- Definition, Need and Advantages, Tool holders and Work Holding Devices - Applications.

**UNIT IV CNC PROGRAMMING 9 hours**

Manual Part Programming, Computer Aided Part Programming - Definition and importance of various positions like machine zero home position, work piece zero, and program zero, coordinate system- ISO-G Codes and M-codes for turning and milling machining.

Simple and Complex part programming for turning and milling using ISO format having straight turning, taper turning (linear interpolation) and concave/ convex turning (circular interpolation), Need for and Importance of various compensations: Tool length compensation, Tool radius compensation, Pitch error compensation, Tool offset.

**UNIT V INTRODUCTION TO FMS, INDUSTRY 4.0 & 5.0 9 hours**

**Flexible Manufacturing Systems**: Systems-Characteristics-Cost-benefit analysis and productivity improvement, technological justification-planning, installation, operation and evaluation issues-role of group technology (GT) and JIT in FMS-typical case studies, future prospects.

**Trends in manufacturing systems:** Concepts of Reconfigurable manufacturing, Sustainable manufacturing and lean & agile manufacturing.

**Industry 4.0**: Definition, scope, and objectives of Industry 4.0, Integrations in Industry 4.0 - Key technologies.

**Industry 5.0**: Industry 5.0: Definition, Scope, Objectives, and Technological Integrations.

**Course Outcomes:**

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

CO1: Explain the role of CAD/CAM systems in industries and illustrate basic computer graphics techniques and CAD data exchange formats. (L2)

CO2: Apply mathematical techniques to model curves and surfaces using Hermite, Bezier, and B-Spline formulations and construct basic solid models using CSG and B-Rep techniques. (L3)

CO3: Describe the components and operation of CNC machines and explain the significance of tool handling systems and feedback mechanisms in automation. (L2)

CO4: Analyze part programs using G and M codes for various CNC machining operations and develop simple and complex CNC programs incorporating necessary compensations. (L4)

CO5: Explain the architecture and benefits of FMS and discuss the key concepts and enabling technologies of Industry 4.0 and Industry 5.0. (L2)

**Text Books:**

1. Groover, M. P. (2020). Automation, production systems, and computer-integrated manufacturing (5th ed.). Pearson.
2. Zeid, I., & Sivasubramanian, R. (2021). CAD/CAM: Theory and practice (3rd ed.). McGraw Hill Education.
3. Alavala, C. R. (2022). CAD/CAM: Concepts and applications. PHI Learning.

**Reference Books:**

1. Rao, P. N. (2023). CAD/CAM principles and applications (4th ed.). McGraw Hill Education.
2. Groover, M. P. (2023). Fundamentals of modern manufacturing: Materials, processes, and systems (8th ed.). Wiley.
3. Abellan-Nebot, J. V., Vila Pastor, C., & Siller, H. R. (2025). Manufacturing process planning: A practical approach for mechanical engineering. Wiley.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**B. Tech III Year II Semester**

## 23ME114 DESIGN OF MACHINE ELEMENTS

| L | T | P | C |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

**Pre-requisite:** 23ME104 MECHANICS OF SOLIDS

**Course Objectives:**

This course is designed to:

1. Introduce the fundamental principles of machine design, including material selection, design steps, and stress analysis.
2. Equip students with knowledge of failure theories and fatigue design for analyzing mechanical components under fluctuating loads.
3. Impart knowledge on the design and performance evaluation of fasteners, riveted joints, and cotter joints.
4. Develop the ability to design welded joints, shafts, and couplings considering different loading conditions.
5. Enable students to design mechanical springs and spur gears considering strength, deflection, and wear.

### UNIT I INTRODUCTION TO MACHINE DESIGN 9 hours

**Machine Design Fundamentals:** General considerations of design, design process, Preferred sizes, Selection of engineering materials, Manufacturing considerations, fits/tolerances, and fracture toughness basics.

**Stress Analysis in Machine Design:** Design of simple machine parts, Design of components subjected to combined stresses. Factor of Safety.

**Software and Solvers:** Introduction to list of software and solvers for design and analysis of various machine components.

### UNIT II FAILURE THEORIES & FATIGUE DESIGN 9 hours

**Failure Theories:** Maximum Normal Stress Theory, Maximum Shear Stress Theory, Distortion Energy Theory, Maximum Principal Strain Theory, and Brittle Fracture Theory.

**Fatigue Design:** Fatigue loading: Stress concentration, notch sensitivity, endurance limit, S-N curve.

**Design under fluctuating loads:** Goodman, Soderberg and Gerber equations, Fracture toughness and impact considerations.

### UNIT III DESIGN OF FASTENERS, RIVETS & COTTERS 9 hours

**Threaded fasteners:** Strength calculations, preloading, eccentric loading.

**Riveted joints:** Failure modes, efficiency, applications.

**Cotters, knuckle joints:** Design and selection criteria.

### UNIT IV DESIGN OF WELDED JOINTS, SHAFTS & COUPLINGS 9 hours

**Welded joints:** Fillet & butt welds, stress analysis for axial, torsional, eccentric loading.

**Shafts:** Design for bending, torsion, and combined loads. Shaft diameter calculations.

**Couplings:** Muff, flange, flexible and rigid couplings – design procedures.

**UNIT V SPRING & GEAR DESIGN 9 hours**

**Helical Springs:** Spring materials, Stress and deflections of helical Springs, Design of helical springs for static and dynamic loading, Surge in springs.

**Leaf springs:** Multi leaf springs, Equalized stresses in spring leaves (nipping).

**Design of Spur Gears:** Selection of gear material, Lewis equation – Estimation of module based on beam strength, Buckingham's equation – Estimation of module based on wear strength.

**Course Outcomes:**

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

CO1: Apply basic design principles and material selection criteria to analyze stresses in machine components and determine factor of safety. (L3)

CO2: Analyze mechanical components using static and fatigue failure theories and apply endurance-based criteria such as Goodman and Soderberg equations. (L4)

CO3: Apply design principles to determine the strength, failure modes, and selection of threaded fasteners, riveted joints, and cotters. (L3)

CO4: Apply appropriate stress analysis methods to design welded joints and shafts and select suitable couplings for power transmission. (L3)

CO5: Apply strength and deflection formulas to design helical/leaf springs and determine gear dimensions using Lewis and Buckingham equations. (L3)

**Text Books:**

1. Sharma, P. C., & Aggarwal, D. K. (2021). Machine design (12th ed.). S. K. Kataria & Sons.
2. Shigley, J. E., Mischke, C. R., Budynas, R. G., & Nisbett, K. M. (2020). Shigley's mechanical engineering design (11th ed.). McGraw Hill Education.
3. Bhandari, V. B. (2022). Design of machine elements (5th ed.). McGraw Hill Education.

**Reference Books:**

1. Norton, R. L. (2019). Machine design: An integrated approach (6th ed.). Pearson Education.
2. Black, P. H., & O. Eugene, A. (2021). Machine design (Revised ed.). Tata McGraw Hill.
3. Juvinall, R. C., & Marshek, K. M. (2017). Fundamentals of machine component design (6th ed.). Wiley.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**B. Tech III Year II Semester**

## 23ME209 THERMAL ENGINEERING LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Pre-requisite: None**

**Course Objectives:**

This course is designed to:

1. Provide hands-on experience in dismantling and assembling internal combustion (IC) engines to understand their construction and function.
2. Facilitate the analysis of port and valve timing for both two-stroke and four-stroke engines.
3. Assess engine performance parameters such as power, efficiency, friction, and heat balance under various operating conditions.
4. Enable students to perform and interpret emission testing, air compression, and psychrometric measurements.
5. Offer exposure to auxiliary systems such as vapour compression refrigeration rigs and boilers used in thermal engineering applications.

**List of Experiments:**

1. Dismantling and assembly of engines to identify the parts and their positions.
2. Port and valve timing diagrams of an 2-stroke and 4-stroke I.C. engines.
3. Performance test on a 4 -stroke diesel engine.
4. Performance test on 2-stroke petrol engine.
5. Evaluation of engine friction by conducting morse test on 4-stroke multi cylinder engine.
6. Heat balance test on an I.C. Engine.
7. Study on performance characteristics of a variable compression ratio engine.
8. Exhaust emission test on I.C. engines.
9. Performance test on reciprocating air compressor unit.
10. Determination of WBT, DBT, RH of moist air.
11. Study on vapour compression test rig.
12. Study of boilers.

**Course Outcomes:**

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

CO1: Identify engine components and demonstrate the correct procedure for dismantling and reassembling IC engines. (L2)

CO2: Construct valve and port timing diagrams and analyze their implications on engine performance. (L3)

CO3: Conduct performance and heat balance tests on various IC engines and interpret the results to evaluate efficiency. (L4)

CO4: Measure engine friction using Morse test and examine its effect on engine output. (L4)

CO5: Evaluate psychrometric properties of air and compare the performance of thermal systems like compressors, refrigeration rigs, and boilers. (L3)

**Reference Books:**

1. Lab manual provided by the department.

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination

**B. Tech III Year II Semester**

## 23ME210 CAD/CAM LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Pre-requisite: None**

**Course Objectives:**

This course is designed to:

1. Introduce the application of Finite Element Analysis (FEA) for structural problems involving point loads, distributed loads, and symmetric structures.
2. Develop competency in thermal and buckling analysis using numerical simulation tools.
3. Impart knowledge on modal analysis for evaluating natural frequencies and mode shapes of structural components.
4. Expose students to heat transfer simulations, including conduction and radiation between surfaces.
5. Provide hands-on training in CNC machining simulations, covering turning, tapering, chamfering, milling, and facing operations.

**List of Experiments:**

1. Analysis of cantilever beam with point load at free end.
2. Analysis of distributed loading of a 1D simply supported beam.
3. Buckling failure analysis.
4. Stress analysis of axi-symmetry structure.
5. Analysis of 2D truss.
6. Modal analysis of a cantilever beam & plate.
7. 1D heat conduction thermal analysis.
8. Analysis of radiation exchange between surfaces.
9. Simulation of CNC step turning and facing.
10. Simulation of CNC taper turning and chamfering.
11. Simple turning, milling, chamfering and fillet operation using CNC.

**Course Outcomes:**

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

CO1: Apply FEM techniques to analyze structural components such as cantilever and simply supported beams under various loading conditions. (L3)

CO2: Analyze structural stability and determine critical buckling loads for components using simulation tools. (L4)

CO3: Evaluate thermal behavior in 1D heat conduction problems and assess radiative heat exchange using appropriate software. (L5)

CO4: Understand modal characteristics of mechanical components through simulation of vibration and frequency response. (L2)

CO5: Create CNC machining tool paths for various operations and simulate turning, facing, and contouring processes. (L6)

**Reference Books:**

1. Lab manual provided by the department.

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination

**B. Tech III Year II Semester**

## 23ENG901 TECHNICAL PAPER WRITING AND IPR

| L | T | P | C |
|---|---|---|---|
| 2 | 0 | 0 | 0 |

**Pre-requisite:** None

**Course Objectives:**

1. To enable the students to practice the basic skills of research paper writing
2. To make the students understand the importance of IP and to educate them on the basic concepts of Intellectual Property Rights.
3. To practice the basic skills of performing quality literature review
4. To help them in knowing the significance of real life practice and procedure of Patents.
5. To enable them learn the procedure of obtaining Patents, Copyrights, & Trade Marks

**UNIT I** **6 hours**

Principles of Technical Writing: styles in technical writing; clarity, precision, coherence and logical sequence in writing-avoiding ambiguity- repetition, and vague language - highlighting your findings-discussing your limitations -hedging and criticizing -plagiarism and paraphrasing.

**UNIT II** **6 hours**

Technical Research Paper Writing: Abstract- Objectives-Limitations-Review of Literature- Problems and Framing Research Questions- Synopsis

**UNIT III** **6 hours**

Process of research: publication mechanism: types of journals- indexing- seminars- conferences- proof reading –plagiarism style; seminar & conference paper writing; Methodology-discussion-results-citation rules.

**UNIT IV** **6 hours**

**Introduction to Intellectual property:** Introduction, types of intellectual property, International organizations, ncies and treaties, importance of intellectual property rights

**de Marks**: Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting evaluating trade mark, trade mark registration processes.

**UNIT V** **6 hours**

**Law of copy rights**: Fundamentals of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law

**Law of patents:** Foundation of patent law, patent searching process, ownership rights and transfer. Patent law, intellectual property audits.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

CO1: Identify key secondary literature related to their proposed technical paper writing.
CO2: Explain various principles and styles in technical writing
CO3: Use the acquired knowledge in writing a research/technical paper
CO4: Analyse rights and responsibilities of the holder of Patent, Copyright, Trademark, International Trademark etc.
CO5: Evaluate different forms of IPR available at National & international levels

CO6: Develop skill of making search of various forms of IPR by using dern tools and techniques.

**Text Books:**

**1.** Deborah. E. Bouchoux, Intellectual Property Rights, Cengage Learning India, 2013

**2.** Meenakshi Raman, Sangeeta Sharma. Technical Communication: Principles and Practives. Oxford.

**Reference Books:**

**1.** R.Myneni, Law of Intellectual Property, 9th Ed, Asia law House, 2019.

**2.** Prabuddha Ganguli, Intellectual Property Rights Tata Mcgraw Hill, 2001

**3.** P.Naryan, Intellectual Property Law, 3rd Ed ,Eastern Law House, 2007.

**4.** Adrian Wallwork. English for Writing Research Papers Second Edition. Springer Cham Heidelberg New York ,2016

**5.** Dan Jones, Sam Dragga, Technical Writing Style

**Online Learning Resources**

1. https://theconceptwriters.com.pk/principles-of-technical-writing/
2. https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriti ng.html
3. https://www.ewh.ieee.org/soc/emcs/acstrial/newsletters/summer10/TechPaperWriti ng.html
4. https://www.manuscriptedit.com/scholar-hangout/process-publishing-research-paper- journal/
5. https://www.icsi.edu/media/website/IntellectualPropertyRightLaws&Practice.pdf
6. https://lawbhoomi.com/intellectual-property-rights-notes/
7. https://www.extension.purdue.edu/extmedia/ec/ec-723.pdf

**Mode of Evaluation:** Assignments and Mid Term Tests

# OPEN ELECTIVE – I

**Open Elective – I**

## 23HUM301 INDIAN KNOWLEDGE SYSTEM

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** Nil

**Course Objectives:**

The main objectives of the course is to

1. To introduce the scope, significance, and interdisciplinary nature of Indian Knowledge Systems and their relevance in the modern world.
2. To explore the philosophical and epistemological foundations of Indian Knowledge Systems, including key concepts like Pramāṇa, Dharma, and Rta.
3. To examine the scientific contributions of ancient India in fields such as mathematics, astronomy, medicine, and engineering.
4. To understand Indian perspectives on society, governance, literature, and aesthetics through classical texts and traditions.
5. To appreciate the cultural richness, ethical values, and traditional educational systems that shaped Indian civilization.

**UNIT I INDIAN KNOWLEDGE SYSTEM: AN INTRODUCTION 9 hours**

Indian Knowledge System: An Overview- Historical evolution and contemporary Relevance-Interdisciplinary approach and integration in education-The Vedic Corpus, The Four Vedas and their components, Oral transmission and cultural continuity--Philosophical Systems, Orthodox (Āstika) and Heterodox (Nāstika) schools, Logic, metaphysics, and epistemology in Indian philosophy -Wisdom through the Ages- Scientific and Mathematical Contributions, Ayurveda, Astronomy, Metallurgy, Mathematics, Key scholars: Charaka, Sushruta, Aryabhata, Bhaskaracharya

**UNIT II FOUNDATIONAL CONCEPTS IN INDIAN KNOWLEDGE SYSTEMS 9 hours**

Shaping India's intellectual traditions- Ancient Indian linguistics, highlighting phonetics, grammar, and language philosophy-traditional number systems, units of measurement, and their practical applications in science and trade -indigenous frameworks for organizing and classifying knowledge, offering insights into how Indian scholars approached learning, epistemology, and the systemic cultivation of wisdom across disciplines.

**UNIT III SCIENCE AND TECHNOLOGY IN INDIAN KNOWLEDGE SYSTEMS 9 hours**

India’s classical achievements in mathematics, astronomy, architecture, and science. Learners explore ancient texts and applications—highlighting concepts like zero, planetary motion, and structural design. integration of science with philosophy and sustainability. Through notable scholars and indigenous techniques, how Indian scientific thought continues to influence contemporary innovations-offering wisdom for solving modern challenges.

**UNIT IV HUMANITIES AND SOCIAL SCIENCES IN INDIAN KNOWLEDGE SYSTEMS 9 hours**

Indian insights on leadership, wellbeing, and governance through ancient texts like the Srimad Bhagavad Gita. Topics include holistic management principles, psychological well-being, ethical governance, and traditional administrative models—emphasizing their relevance to modern society, personal growth, and nation-building.

**UNT V CULTURAL, EDUCATIONAL, AND ETHICAL DIMENSIONS OF INDIAN KNOWLEDGE SYSTEMS** **9 hours**

**Art, Architecture, and Aesthetics**-Temple architecture and sculpture-Music, dance, and literary traditions-**Education Systems and Institutions,** Gurukula system and pedagogical practices, Ancient universities: Nalanda, Takshashila-**Ethics and Values in Indian Thought**-Dharma, Karma, Moksha — principles of righteous living, Sustainability, harmony, and spiritual ecology-**Contemporary Relevance and Global Influence,** Indian knowledge systems in modern science and culture, Resurgence through NEP 2020 and academic initiatives

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

CO1: Learners will be able to **describe** the scope and interdisciplinary relevance of Indian Knowledge Systems in contemporary contexts.

CO2: Learners will be able to **analyze** foundational philosophical concepts such as *Pramāṇa*, *Dharma*, and *Rta* within Indian epistemology.

CO3: Learners will be able to **apply** ancient Indian scientific principles to understand traditional practices in mathematics, astronomy, and medicine.

CO4: Learners will be able to **evaluate** classical Indian texts to interpret perspectives on governance, society, and aesthetics.

CO5: Learners will be able to **design** culturally informed ethical frameworks and educational models inspired by traditional Indian systems.

**Reference Books:**

1. Introduction to Indian knowledge system: concepts and applications
   By B. Mahadevan , Nagendra Pavana , Vinayak Rajat Bhat, PHI publications
2. Bhagavad Gita: As It Is" by A.C. Bhaktivedanta Swami Prabhupada Published by The Bhaktivedanta Book Trust
3. "Indian Philosophy, Volume 1 and 2 by S. Radhakrishnan Published by Oxford university press.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Open Elective – I**

## 23MAT302 ENGINEERING OPTIMIZATION

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** 23MAT101, 23MAT102, 23MAT104

**Course Description:**
Unconstrained and constrained optimization, Linear programming problem, transportation and assignment problems, dynamic programming problem, project management and queuing models.

**Course Objectives:**
The main objectives of the course is to

1. Understand the optimization techniques for solving engineering problems.
2. Formulate and solve linear programming problem.
3. Obtain the optimal solution for transportation and assignment problems.
4. Avail knowledge to apply the game theory and project management techniques to find the solutions to the complex problems.
5. Understand the basic characteristic features of a queuing system and acquire skills in analyzing queuing models.

**UNIT I CLASSICAL OPTIMIZATION 9 hours**

Introduction to optimization, unconstrained optimization with single variable and multi variable. Constrained multivariable optimization with equality constraints- Lagrange multipliers method, constrained multivariable optimization with inequality constraints - Kuhn-Tucker conditions.

**UNIT II LINEAR PROGRAMMING PROBLEM 9 hours**

Linear Programming Problem (LPP), Mathematical formulation, graphical solution, simplex method. Artificial variable technique - Big M-method and two phase simplex method. Duality, dual Simplex method.

**UNIT III TRANSPORTATION PROBLEM AND ASSIGNMENT PROBLEM 9 hours**

Transportation problem: definition and algorithm, transshipment problem. Assignment problem, travelling salesman problem.

**UNIT IV GAME THEORY AND PROJECT MANAGEMENT 9 hours**

Formulation of games, Two Person-Zero sum game, games with and without saddle point, Graphical solution (2x n, m x 2 game), dominance property. Network analysis: Network representation, Critical Path Method (CPM) and Project Evolutionary and Review Technique (PERT).

**UNIT V QUEUING MODELS 9 hours**

Introduction to queuing system, Birth and Death processes, Single and multiple server queueing models, Little's formula - Finite Calling Population Queuing Models – Multi-Phase Service Queuing Model.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

CO1: Understood the importance of unconstrained and constrained optimization to solve engineering problems.

CO2: Get an idea about the linear programming techniques.

CO3: Solve transportation and assignment problems in engineering situations.

CO4: Analyze the problems of network analysis for project management and game theory.

CO5: Apply the Queuing system models to solve problems in engineering & industry.

**Text Books:**

**1.** J K Sharma, Operations Research: Theory and Practice, Macmillan Publishers India Ltd, 5th edition,2013.

**2.** B.S. Grewal, Higher Engineering Mathematics, 43rd edition (2014), Khanna publishers.

**Reference Books:**

**1.** Hamdy A Taha, Operations Research: An Introduction, Pearson Education, 9/E, 2011.

**2.** FS Hillier and GJ Lieberman, Introduction to Operations Research, TMH, 8/E, 2006.

**3.** JC Pant, Introduction to Optimization: Operations Research, Jain Brothers, New, 6/E, 2004.

**4.** A Ravindran, DT Philips and JJ Solberg, Operations Research: Principles and Practice, John Wiley& Sons, Singapore, 2nd edition.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Open Elective – I**

## 23PHY301 LASER PHYSICS AND ADVANCED LASER TECHNOLOGY

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** Basic knowledge of atomic structure at intermediate (10+2) level is sufficient

**Course Description:**

Laser usage is rampant in various technological applications. Several fields gaining attention in the usage of lasers. This course covers the introduction to the theory and mechanism of laser action, various types of lasers and their applications and future use.

**Course Objectives:**

The main objectives of the course is to

1. Make the student to understand the detailed principles of various lasers.
2. Profound understanding of different variety of lasers will provide them to think of superior selection and usage of lasers in practical technological applications.
3. Students are aware of latest developments in certain areas of Laser technology which have important applications for societal needs.
4. Explain how material processing is accomplished with lasers. Estimate laser operation parameters for material processing.
5. Exposure about Lasers applications in engineering, communications, spectroscopy and material process etc.

### UNIT I INTRODUCTION TO LASER TECHNOLOGY 9 hours

Laser characteristics, The Einstein Coefficients, Absorption and Emission Cross Sections, Spontaneous and Stimulated emission of radiation, Population inversion, Methods of Population Inversion, Laser Rate Equations, stable two minor optical resonators, Mode selection, Gain in the regenerative laser cavity.

### UNIT II GASES AND LIQUIDS LASING MEDIUM 9 hours

Energy levels & Radiative properties of Atoms and molecules**;** *Atomic lasers*: He-Ne laser, Argon Ion laser**;** *Molecular Lasers*: Carbon dioxide laser, Liquid energy levels and their radiative properties, Organic Dye laser.

### UNIT III SOLID STATE LASERS 9 hours

Energy Levels in solids-dielectric medium, Solid-state lasing materials, Narrow line width laser materials, broad band line width laser materials, solid state lasers: Nd:YAG, Nd:YLF; Ti:Sapphire (introduction only)

Energy Levels in solids-semiconductor medium, direct and indirect band gap semiconductors, Semiconductor diode laser, Quantum dot lasers (Introduction only)

### UNIT IV PULSED OPERATION OF LASERS 9 hours

Nanosecond: Q-Switching, Techniques of Q-Switching: electro-optic, Acousto-Optic.Femtosecond: Relationship between pulse duration and Spectral Width, Passive mode-locking, Active mode locking, Kerr lens mode locking, Amplification of femtosecond pulses.

**UNIT V LASER APPLICATIONS** **9 hours**

Laser processing of materials: laser cutting, laser drilling, welding; Lasers in metrology- Accurate measurement of length, light wave communications; Laser spectroscopy: Laser fluorescence and Raman scattering.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

CO1: Understand the principle of phenomenon of laser and identify the operating principle involved in various type of lasers.

CO2: Estimate stability requirements in producing laser light by different types of sources

CO2: CO3: Differentiate or list the various types of lasers and their means of excitation.

CO4: Assess (Identify) which laser would best meet the need for a particular industrial or research task.

CO5: Student can knowledge of latest technological developments in laser technology. Femtosecond laser etc.

**Text Books:**

**1.** Laser Fundamentals: William T Silfvast. Cambridge Publication.

**2.** Laser Theory and Applications: A.K. Ghatak and K. Thyagarajan, Springer

**3.** Femtosecond Laser Pulses Principles and Experiments: Claude Rulli`ere, Springer

**4.** Principles of Laser: O. Svelto

**5.** Laser Physics: Peter W Miloni, Joseph H Eberly.

**Reference Books:**

**1.** Solid State Laser Engineering: Walter Koechner. Springer series in optical sciences.

**2.** Ultrafast Optics, Andrew M. Weiner

**3.** Laser spectroscopy: Demtroder

**4.** Laser Applications: Monte Ross

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Open Elective – I**

## 23PHY302 THIN FILM TECHNOLOGY AND ITS APPLICATIONS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** None

**Course Description:**

Nucleation, crystallization, surface energy, various thin film coating processes including both physical vapour deposition such as evaporation, sputtering, pulsed laser deposition and chemical vapour deposition, spray coating, and other methods such as spin-coating, plasma polymerization, Langmuir Blodgett, transport phenomena in thin films, various properties of thin films, techniques and method to characterize thin films, current application of thin film, introduction to fabrication of thin film devices

**Course Objectives:**

The main objectives of the course is to

1. To provide students with a comprehensive overview on the fundamentals of thin film preparation and characterization.
2. To enable the students to develop a thorough understanding of how core physics can be used to understand thin film deposition processes.
3. To establish the correlation between processing variables and materials characteristics and performance within the framework of key modern technologies.
4. To realize thin film applications to science and technology

**UNIT I PHYSICS OF THIN FILMS** **8 hours**

Introduction - Role of thin films in devices - Thin film definition - Crystalline and amorphous films - Crystal defects - Nucleation and growth - film formation.

**UNIT II THIN FILM DEPOSITION TECHNIQUES** **10 hours**

Physical methods of films deposition-evaporation, e-beam, sputter deposition, pulsed laser, molecular beam epitaxy. Chemical methods of film deposition -Deposition of Inorganic films from Solutions-Chemical vapour deposition - Electrolysis, Anodization, Spray pyrolysis, Other techniques: Langmuir Blodgett and Spin Coating.

**UNIT III PROPERTIES OF THIN FILMS** **8 hours**

Structural-Optical-Electrical-Magnetic-Mechanical and Thermal properties of thin films

**UNIT IV CHARACTERIZATION OF THIN FILMS** **10 hours**

Imaging Techniques (SEM, AFM, TEM) - Structural Techniques (XRD, Raman)-Optical Techniques (UV-Vis-NIR, PL)-Electrical Techniques (Hall Effect, IV, CV)-Magnetic Techniques (EPR, H-V curve)-Mechanical Techniques (Hardness testing)-Thickness measurement (profilometer, ellipsometry).

**UNIT V APPLICATIONS OF THIN FILMS** **9 hours**

Transparent conducting coating - Optical coating – Solar cells – Photocatalytic – Sensors - Superconductivity- Superhard coatings – Thin film transistors.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

CO1: Discuss the differences and similarities between different vacuum based deposition techniques, evaluate and use models for nucleating and growth of thin films.

CO2: Asses the relation between deposition technique, film structure, and film properties.

CO3: Know the typical thin film applications.

CO4: Motivate selection of deposition techniques for various applications.

**Text Books:**

**1.** Thin Film Deposition: Principles and Practice, *Donald L. Smith*, McGraw Hill, Singapore, 2001.

**2.** Maissel, L.I and Glang. R, "Handbook of thin film technology", McGraw Hill, 1970.

**Reference Books:**

**1.** Thin film phenomena / *Kasturi L. Chopra,* New York: McGraw-Hill, c1969.

**2.** G. Cao, "Nanostructures & Nanomaterials: Synthesis, Properties & Applications" Imperial College Press, 2004.

**3.** An introduction to physics and technology of thin films / *Alfred Wagendristel, Yuming Wang*, Singapore: World Scientific, c1994.

**4.** Thin film processes, *John L Vossen, Werner Kehn* editors, Academic Press, New York, 1978.

**5.** Thin film physics / *O.S. Heavens*, London: Methuen, c1970.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Open Elective – I**

## 23PHY303 WASTE TO SUSTAINABLE ENERGY AND ENERGY SYSTEMS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** Basic knowledge of Physics and chemistry at the intermediate (10+2) level is sufficient

**Course Description:**

This course covers waste-to-energy conversion and energy storage technologies, including thermal, biological, and chemical methods. It introduces relevant policies, case studies, and trends to help students design sustainable energy solutions aligned with the circular economy and climate goals.

**Course Objectives:**

The main objectives of the course is to

1. Understand various methods of energy generation from waste.
2. To explore thermal, biological, and chemical conversion technologies.
3. To examine modern energy storage devices and their integration with waste-to-energy systems.
4. To analyse the techno-economic feasibility of these systems for sustainable development.
5. To develop interdisciplinary skills in waste-to-energy technologies, enhancing student employability in sustainable energy and environmental sectors.

**UNIT I INTRODUCTION TO WASTE PROCESSING, TRANSPORT, AND MANAGEMENT** **9 hours**

Types of Wastes, Agricultural Residues, and Wastes Including Animal Wastes, Industrial Wastes, Municipal Solid Wastes and Characterization. Waste Processing Types and Composition of Various Types of Wastes- Industrial Waste and Biomedical Waste- Waste Collection and Transportation- Waste Processing- Size Reduction, Separation- Waste Management Hierarchy- Waste Minimization and Recycling of Municipal Solid Waste.

**UNIT II THERMAL WASTE CONVERSION TECHNOLOGIES** **9 hours**

Combustion, incineration, pyrolysis, gasification, Process parameters, design considerations, Emission control, energy recovery, and Case studies of WTE (Waste to Energy) plants in India and abroad

**UNIT III BIOLOGICAL AND CHEMICAL CONVERSION** **9 hours**

Bio gasification: Biomethanation process, biogas digester types. Chemical Conversion: Hydrolysis & hydrogenation; solvent extraction of hydrocarbons; solvolysis of wood, bio crude, biodiesel production via chemical process; transesterification methods; Chemicals from biomass.

**UNIT IV ENERGY STORAGE SYSTEMS** **9 hours**

Introduction to Energy Storage Systems - Types of energy storage- electrical, mechanical, chemical, thermal; Batteries (Li-ion, lead-acid, flow batteries), Supercapacitors and hybrid storage, Hydrogen storage and fuel cells.

**UNIT V WASTE MANAGEMENT AND ENERGY RECOVERY** **9 hours**

Characteristics and Perspectives of Waste, Unit Operations & Transformation Technologies, Waste Disposal, Hazardous Waste Management & Waste Recycling

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

CO1: To understand various methods of energy recovery from waste.

CO2: To explore thermal conversion technologies.

CO3: To explore biological and chemical conversion technologies

CO4: To examine modern energy storage devices and their integration with waste-to-energy systems.

CO5: To analyse the techno-economic feasibility of these systems for sustainable development.

**Text Books:**


1. Waste-to-Energy. Technologies and Project Implementation by Marc J. Rogoff And Francois Screve (Auth.) Publisher: William Andrew, 2011/2019
2. Robert C. Brown Thermo-chemical Processing of Biomass: Conversion into Fuels, Chemicals and Power, John Wiley and Sons, 2019.
3. Sergio Capareda, Introduction to Biomass Energy Conversions, CRC Press, 2013.
4. Fundamentals of Energy Storage, J. Jensen, B. Squrensen, John Wiley, NY
5. Techobanoglous, Theisen, and Vigil, "Integrated Solid Waste Management", 2d Ed. McGraw-Hill, New York, 1993.


**Reference Books:**


1. Industrial and Urban Waste Management in India, TERI Press
2. B. Lal and M. Patwardhan, "Wealth from Waste: Trends and Technologies", TERI Press
3. Municipal Solid Waste to Energy Conversion Processes: Processes Technical, and Renewable comparisons, by Gary C. Young, ISBN:9780470539675, Publisher: John Wiley & Sons, Publication Date: June 2010.
4. Parker Colin, and Roberts, "Energy from Waste – An Evaluation of Conversion Technologies", Elsevier Applied Science, London, 1985.
5. La Grega, M., et al., "Hazardous Waste Management", McGraw-Hill, c. 1200 pp., 2nd ed.,2001


**Journals & Reviews:**

1. Updated Journals and Reviews of the last 5 Years
2. Home (https://swayam.gov.in) > Courses (https://swayam.gov.in/explorer) > Waste to Energy Conversion, By Prof. P. Mondal | IIT Roorkee

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Open Elective – I**

## 23CHE301 CHEMISTRY OF POLYMERS AND ITS APPLICATIONS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite: None**

**Course Objectives:**

The main objectives of the course is to

1. To understand the basic principles of polymers
2. To understand natural polymers and their applications.
3. To impart knowledge to the students about synthetic polymers, their preparation and importance.
4. To enumerate the applications of hydogel polymers
5. To enumerate applications of conducting and degradable polymers in engineering.

### UNIT I POLYMERS-BASICS AND CHARACTERIZATION:- 9 hours

Basic concepts: monomers, repeating units, degree of polymerization, linear, branched and network polymers, classification of polymers, Polymerization: addition, condensation, copolymerization and coordination polymerization. Average molecular weight concepts: number, weight and viscosity average molecular weights, polydispersity and molecular weight distribution. Measurement of molecular weight: End group, viscosity, light scattering, osmotic and ultracentrifugation methods, analysis and testing of polymers.

### UNIT II NATURAL POLYMERS & MODIFIED CELLULOSICS 9 hours

Natural Polymers: Chemical & Physical structure, properties, source, important chemical modifications, applications of polymers such as cellulose, lignin, starch, rosin, shellac, latexes, vegetable oils and gums, proteins.

Modified cellulosics: Cellulose esters and ethers such as Ethyl cellulose, CMC, HPMC, cellulose acetals, Liquid crystalline polymers; specialty plastics- PES, PAES, PEEK, PEA.

### UNIT III SYNTHETIC POLYMERS 9 hours

Addition and condensation polymerization processes– Bulk, Solution, Suspension and Emulsion polymerization. Preparation and significance, classification of polymers based on physical properties. Thermoplastics, Thermosetting plastics, Fibers and elastomers, General Applications. Preparation of Polymers based on different types of monomers, Olefin polymers(PE,PVC), Butadiene polymers(BUNA-S,BUNA-N), nylons, Urea-formaldehyde, phenol – formaldehyde, Melamine Epoxy and Ion exchange resins.

### UNIT IV HYDROGELS OF POLYMER NETWORKS 9 hours

Definitions of Hydrogel, polymer networks, Types of polymer networks, Methods involved in hydrogel preparation, Classification, Properties of hydrogels, Applications of hydrogels in drug delivery.

### UNIT V CONDUCTING AND DEGRADABLE POLYMERS: 9 hours

**Conducting polymers**: Introduction, Classification, Mechanism of conduction in Poly Acetylene, Poly Aniline, Poly Thiophene, Doping, Applications.

**Degradable polymers**: Introduction, Classifications, Examples, Mechanism of degradation, poly lactic acid, Nylon-6, Polyesters, applications.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

CO1: Classify the polymers, explain polymerization mechanism, differentiate addition, condensation polymerizations, Describe measurement of molecular weight of polymer

CO2: Describe the physical and chemical properties of natural polymers and Modified cellulosics.

CO3: Differentiate Bulk, solution, Suspension and emulsion polymerization, describe fibers and elastomers, Identify the thermosetting and thermo polymers.

CO4: Identify types of polymer networks, describe methods involve in hydrogel preparation, Explain applications of hydrogels in drug delivery,

CO5: Explain classification and mechanism of conducting and degradable polymers.

**Text Books:**

1. A Text book of Polymer science, Billmayer
2. Polymer Chemistry – G.S.Mishra
3. Polymer Chemistry – Gowarikar

**Reference Books:**

1. Organic polymer Chemistry, K.J.Saunders, Chapman and Hall
2. Advanced Organic Chemistry, B.Miller, Prentice Hall
3. Polymer Science and Technology by Premamoy Ghosh, 3rd edition, McGraw-Hill, 2010.

**Online Learning Resources**

1. https://nptel.ac.in/courses/104105124

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Open Elective – I**

## 23CHE302 GREEN CHEMISTRY AND CATALYSIS FOR SUSTAINABLE ENVIRONMENT

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite: None**

**Course Objectives:**

The main objectives of the course is to

1. Learn an interdisciplinary approach to the scientific and societal issues arising from industrial chemical production, including the facets of chemistry and environmental health sciences that can be integrated to promote green chemistry
2. Sensitize the students in redesigning of chemicals, industrial processes and products by means of catalysis.
3. Understand the use of alternatives assessments in using environmentally benign solvents.
4. Emphasize current emerging greener technologies and the need of alternative energies.
5. Learn to adopt green chemistry principles in practicing Nanoscience

**UNIT I PRINCIPLES AND CONCEPTS OF GREEN CHEMISTRY 9 hours**

Introduction, Green chemistry Principles, sustainable development and green chemistry, atom economy, atom economic: Rearrangement and addition reactions and un-economic reactions: Substitution, elimination and Wittig reactions, Reducing Toxicity. Waste - problems and Prevention: Design for degradation.

**UNIT II CATALYSIS AND GREEN CHEMISTRY 9 hours**

Introduction to catalysis, Heterogeneous catalysts: Basics of Heterogeneous Catalysis, Zeolites: Catalytic cracking, ZSM-5 catalyst and high silica zeolites, TS1 Oxidation catalyst, Catalytic Converters, Homogeneous catalysis: Hydrogenation of alkenes using wilkinson's catalyst, Phase transfer catalysis: Hazard Reduction, C–C Bond Formation, Oxidation Using Hydrogen Peroxide.

**UNIT III ORGANIC SOLVENTS: ENVIRONMENTALLY BENIGN SOLUTIONS 9 hours**

Organic solvents and volatile organic compounds, solvent free systems, supercritical fluids: Super critical carbondioxide, super critical water and water as a reaction solvent: water based coatings, Ionic liquids as catalyst and solvent.

**UNIT IV EMERGING GREENER TECHNOLOGIES AND ALTERNATIVE ENERGY SOURCES 9 hours**

Biomass as renewable resource, Energy: Fossil Fuels, Energy from Biomass, Solar Power, Fuel Cells(Hydrogen—oxygen fuel cell), Photochemical Reactions: Advantages of and Challenges Faced by Photochemical Processes, Examples of Photochemical Reactions(caprolactum), Chemistry Using Microwaves: Microwave Heating, Microwave-assisted Reactions, Sonochemistry.

**UNIT V GREEN PROCESSES FOR GREEN NANOSCIENCE 9 hours**

Introduction and traditional methods in the nanomaterials synthesis, Translating green chemistry principles for practicing Green Nanoscience. Green Synthesis of Nanophase Inorganic Materials and Metal Oxide Nanoparticles: Hydrothermal Synthesis, Reflux Synthesis, Microwave-Assisted Synthesis, Other methods for Green synthesis of metal and metal oxide nanoparticles, Green chemistry applications of Inorganic nanomaterials

**Course Outcomes:**

Upon completion of this course the students should:

CO1: Recognize green chemistry concepts and apply these ideas to develop respect for the interconnectedness of our world and an ethic of environmental care and sustainability.
CO2: Understand and apply catalysis for developing eco-friendly processes.
CO3: Be in a position to use environmental benign solvents where ever possible.
CO4: Have knowledge of current trends in alternative energy sources.
CO5: Apply green chemistry principles in practicing green Nanoscience.

**Text Books:**

1. M. Lancaster, Green Chemistry an introductory text, Royal Society of Chemistry, 2002.
2. Paul T. Anastas and John C. Warner, Green Chemistry Theory and Practice, 4th Edition, Oxford University Press, USA

**Reference Books:**

1. Edited by Alvise Perosa and Maurizio Selva , Hand Book of Green chemistry Volume 8: Green Nanoscience, wiley-VCH
2. Advanced Organic Chemistry, B.Miller, Prentice Hall
3. Polymer Science and Technology by Premamoy Ghosh, 3rd edition, McGraw-Hill, 2010.

**Online Learning Resources**

1. https://nptel.ac.in/courses/104105124

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Open Elective – I**

## 23CHE303 CHEMISTRY OF ENERGY SYSTEMS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite: NIL**

**Course Objectives:**

1. To make the student understand basic electrochemical principles such as standard electrode potentials, emf and applications of electrochemical principles in the design of batteries.
2. To understand the basic concepts of processing and limitations of Fuel cells & their applications.
3. To impart knowledge to the students about fundamental concepts of photo chemical cells, reactions and applications
4. Necessasity of harnessing alternate energy resources such as solar energy and its basic concepts.
5. To impart knowledge to the students about fundamental concepts of hydrogen storage in different materials and liquification method.

**UNIT I ELECTROCHEMICAL SYSTEMS 9 hours**

Galvanic cell, Nernst equation, standard electrode potential, application of EMF, electrical double layer, polarization, Batteries- Introduction ,Lead-acid ,Nickel- cadmium, Lithium ion batteries and their applications**.**

**UNIT II FUEL CELLS 9 hours**

Fuel cell- Introduction, Basic design of fuel cell, working principle, Classification of fuel cells, Polymer electrolyte membrane (PEM) fuel cells, Solid-oxide fuel cells (SOFC), Fuel cell efficiency and applications.

**UNIT III PHOTO AND PHOTO ELECTROCHEMICAL CONVERSIONS 9 hours**

Photochemical cells Introduction and applications of photochemical reactions, specificity of photo electrochemical cell, advantage of photoelectron catalytic conversions and their applications.

**UNIT IV SOLAR ENERGY 9 hours**

Introduction and prospects, photovoltaic (PV) technology, concentrated solar power (CSP), Solar cells and applications.

**UNIT V HYDROGEN STORAGE 9 hours**

Hydrogen storage and delivery: State-of-the art, Established technologies, Chemical and Physical methods of hydrogen storage, Compressed gas storage, Liquid hydrogen storage, Other storage methods, Hydrogen storage in metal hydrides, metal organic frameworks (MOF), Metal oxide porous structures, hydrogel , and Organic hydrogen carriers.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

CO1: Solve the problems based on electrode potential, Describe the Galvanic Cell Differentiate between Lead acid and Lithium ion batteries, Illustrate the electrical double layer

CO2: Describe the working Principle of Fuel cell, Explain the efficiency of the fuel cell Discuss about the Basic design of fuel cells, Classify the fuel cell

CO3: Differentiate between Photo and Photo electrochemical Conversions, Illustrate the photochemical cells, Identify the applications of photochemical reactions, Interpret advantages

of photoelectron catalytic conversion.

CO4: Apply the photo voltaic technology, Demonstrate about solar energy and prospects Illustrate the Solar cells, Discuss about concentrated solar power

CO5: Differentiate Chemical and Physical methods of hydrogen storage, Discuss the metal organic frame work, Illustrate the carbon and metal oxide porous structures Describe the liquification methods.

**Text Books:**

1. Physical chemistry by Ira N. Levine
2. Essentials of Physical Chemistry, Bahl and Bahl and Tuli.
3. Inorganic Chemistry, Silver and Atkins

**Reference Books:**

1. Fuel Cell Hand Book 7th Edition, by US Department of Energy (EG&G technical services And corporation)
2. Hand book of solar energy and applications by ArvindTiwari and Shyam.
3. Solar energy fundamental, technology and systems by Klaus Jagar et.al.
4. Hydrogen storage by Levine Klebonoff

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Open Elective – I**

## 23CE301 DISASTER MANAGEMENT

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisites:** None

**Course Description:**

The goal of this course is to expose the undergraduate students to different types of disasters and the preparedness needed to mitigate their effects. The course matrix will cover various natural, biological, chemical, and emerging hazards and risks that may cause property loss, loss of lives, and livestock. Thus, the future engineers will understand the social responsibility for the preparedness and mitigation of the damages caused by the disasters.

**Course Objectives:**

1. To make the students aware of disasters and their impact on living beings.
2. To ensure the students understand vulnerability, disasters, disaster prevention, and risk reduction.
3. To gain a preliminary understanding of approaches for the Disaster Risk Reduction (DRR)
4. To enhance awareness of institutional processes available in the country for disaster risk mitigation.
5. To make the students aware of development activities and case studies.

### UNIT I INTRODUCTION 8 hours

Introduction, Etymology of disaster, Concepts and definitions: disaster, hazard, vulnerability, risks, Resilience, prevention, and mitigation.

### UNIT II TYPES OF DISASTERS 10 hours

Types of Disaster; natural disasters (earthquakes, volcanoes, forest fires and explosions, heat and cold waves, floods, draught, cyclones, tsunami, landslides, soil erosion); manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.), hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

### UNIT III DISASTER IMPACTS 9 hours

Disaster Impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

### UNIT IV DISASTER RISK MITIGATION MEASURES 9 hours

Disaster Risk Reduction (DRR) - Disaster management- four phase approach; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications), DRR programmers in India and the activities of National Disaster Management Authority. Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction.

### UNIT V IMPACT OF DEVELOPMENTAL ACTIVITIES 9 hours

Disasters, Environment and Development - Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land use changes, urbanization, etc.), sustainable and environmental friendly recovery; reconstruction and development methods. Different GIS software, basic data types and coordinate systems. Case studies.

**Course Outcomes:**

The students after completing the course will be able to:

CO1: Explain various disaster concepts
CO2: Differentiate between categories of disasters
CO3: Analyze the impact of various types of disasters
CO4: Select disaster risk mitigation measures
CO5: Identify the impact of development activities

**Text Books:**

1. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation

**Reference Books:**

1. http://ndma.gov.in/ (Home page of National Disaster Management Authority)
2. http://www.ndmindia.nic.in/ (National Disaster Management in India, Ministry of Home Affairs).
3. Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
4. Singh B.K., 2008, Handbook of Disaster Management: Techniques & Guidelines, Rajat Publication.
5. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003
6. Inter-Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Open Elective – I**

## 23CE302 GREEN BUILDINGS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisites:** None

**Course Description:**

The course covers various aspects of bioclimatic architecture like climate-sensitive design, passive solar architecture, Water management, green building materials and construction techniques

**Course Objectives:**

1. To introduce concepts of sustainability and bioclimatic design in planning, Construction and life of buildings.
2. To equip students with technical knowledge of energy-efficient Green Buildings.
3. To guide students, through projects, to apply concepts and ideas for the design of a green building by introducing them to green initiatives and ratings.
4. To initiate students in basics of functional design and drawing of the various buildings using the above concepts.
5. To understand different evaluation criteria with various green building rating systems

**UNIT I GREEN BUILDING CONCEPTS 9 hours**

Introduction to bioclimatic architecture- Sustainability in building science and Functional planning- Orientation- Elements of building design and drawing- Building regulations and by-laws
Traditional and Vernacular Architecture- Climate zones- Design Charts- sun path diagram- Solar angles- Indices of thermal comfort- Vernacular buildings in different climate zones.

**UNIT II CLIMATE RESPONSIVE SCIENTIFIC PROCESS OF DESIGN 9 hours**

Introduction- various steps in Site planning- Plan for Building envelope- Land form-Topography-vegetation- water bodies; Orientation- S/V ratio- P/A ratio- Walls, Fenestration- Roof and floors- Active and passive solar strategies- Passive solar architecture.

**UNIT III THERMAL FLOW IN BUILDINGS 9 hours**

Calculation of thermal conductance- Heat flow through different building elements- Ventilation and day lighting- Design and placement of openings- Water management in buildings- Techniques to recycle, reuse and harvest water.

**UNIT IV GREEN BUILDING MATERIALS AND CONSTRUCTION 9 hours**

Material properties- Energy efficiency using various materials- emerging new materials, Construction techniques- Techniques for roof, wall and foundations.

**UNIT V ECONOMY OF GREEN BUILDING 9 hours**

Cost of building- operation and maintenance- Green building rating system- Evaluation criteria of LEED- TERI - GRIHA case studies- Case studies in different climate zones.

**Course Outcomes:**

After successful completion of this course, the student will be able to:

**CO1**: Use various regulations and by-laws for green building construction.
**CO2**: Do site planning, active and passive for Green Building.
**CO3**: Compute thermal flow through different building elements.
**CO4**: Identify energy efficient building materials and construction techniques for building components.
**CO5:** Compute cost of building/operation and maintenance, evaluation criteria for different case studies.

**Text Books:**

1. Krishnan, A., Baker, N., Yannas, S., & Szokolay, S. (Eds.). (2001). Climate responsive architecture, a design handbook for energy efficient buildings. New Delhi: Tata McGraw Hill Publishing Company.
2. TERI & ICAEN (InstitutCatalad'Energia). (2004). Sustainable building design manual (Vol II). New Delhi: The Energy and Resources Institute (TERI) Press

**Reference Books:**

1. Bureau of Indian Standards. (1995). SP:41, Handbook on functional requirements of Buildings (other than industrial buildings) (First reprint ed.). New Delhi: Bureau of Indian Standards.
2. Indian Green Building Council, LEED-India. (2011). LEED 2011 for India- Green building rating system, abridged reference guide for new construction and major renovations (LEED India NC). Hyderabad: Indian Green Building Council
3. Koenigsberger, O., ingersoll, T. G., Mayhew, A., & Skozolay, S. V. (2011). Manual of Tropical Housing and Building. Hyderabad: Universities Press
4. Prabhu, Balagopal T S, K Vincent Paul, and C Vijay an. Building Design and Drawing. Calicut: Spades Publishers, 2008
5. Szokolay, S. V. (2008). Introduction to Architectural Science- The Basis of sustainable Design (Second ed.). Architectural Press/Elsevier
6. The Energy and Resources Institute (TERI). (2011). Green Rating for Integrated Habitat Assessment (GRIHA) manual. New Delhi: TERI press
7. Journals: Energy and Buildings, Building and Environment, Other relevant publications.
8. National Building Code, Bureau of Indian Standards: New Delhi. 2005; Building Bye laws and building rules of selected Indian urban and rural areas
9. Swamy, N. K., & Rao, A. K. (2013). Building planning and Drawing, New Delhi, Charothar Publishing House

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Open Elective - I**

## 23EEE301 ELECTRICAL SAFETY PRACTICES AND STANDARDS

| | L | T | P | C |
|---|---|---|---|---|
| **Pre-requisite:** 23EEE101 | **3** | **0** | **0** | **3** |

**Course Objectives:**

1. To introduce the fundamentals of electrical safety, hazards of electric shock, arc, blast, and failure causes.
2. To explain the function and importance of electrical safety components, voltage classification, and protection devices.
3. To impart knowledge on grounding systems, bonding, and arc hazard categorization to ensure workplace safety.
4. To develop awareness about safety practices across various environments including residential, industrial, and special installations.
5. To familiarize students with relevant electrical safety standards, statutory regulations, and compliance requirements.

**UNIT I INTRODUCTION TO ELECTRICAL SAFETY**: **9 hours**

Fundamentals of Electrical safety-Electric Shock- physiological effects of electric current - Safety requirements –Hazards of electricity- Arc - Blast- Causes for electrical failure.

**UNIT II SAFETY COMPONENTS** **9 hours**

Introduction to conductors and insulators- voltage classification -safety against over voltages- safety against static electricity-Electrical safety equipment‘s - Fire extinguishers for electrical safety.

**UNIT III GROUNDING** **9 hours**

General requirements for grounding and bonding- Definitions- System grounding-Equipment grounding - The Earth - Earthing practices- Determining safe approach distance-Determining arc hazard category.

**UNIT IV SAFETY PRACTICES** **9 hours**

General first aid- Safety in handling hand held electrical appliances tools- Electrical safety in train stations-swimming pools, external lighting installations, medical locations-Case studies.

**UNIT V STANDARDS FOR ELECTRICAL SAFETY** **9 hours**

Electricity Acts- Rules & regulations- Electrical standards-NFPA 70 E-OSHA standards-IEEE standards-National Electrical Code 2005 – National Electric Safety code NESC-Statutory requirements from electrical inspectorate.

**Course Outcomes:**

CO1: Understand the fundamental principles of electrical safety and the physiological effects of electric shock-L2

CO2: Apply knowledge of electrical safety components and protective devices to mitigate over-voltages and static hazards -L3

CO3: Analyze equipment grounding, system grounding, and arc flash hazard categories in practical installations -L4

CO4: Implement appropriate safety procedures in varied environments such as homes, public spaces, and medical areas- L4

CO5: Evaluate the applicability and compliance of electrical systems with respect to national and international safety standards-L5

**Text Books:**

1. Massimo A.G.Mitolo, ―Electrical Safety of Low-Voltage Systems‖, McGraw Hill, USA, 2009.
2. Mohamed El-Sharkawi, ―Electric Safety - Practice and Standards‖, CRC Press, USA, 2014.

**Reference Books:**

1. Kenneth G.Mastrullo, Ray A. Jones, ―The Electrical Safety Program Book‖, Jones and Bartlett Publishers, London, 2nd Edition, 2011.
2. Palmer Hickman, ―Electrical Safety-Related Work Practices‖, Jones & Bartlett Publishers, London, 2009.
3. Fordham Cooper, W., ―Electrical Safety Engineering‖, Butterworth and Company, London, 1986.
4. John Cadick, Mary Capelli-Schellpfeffer, Dennis K. Neitzel, ―Electrical Safety Hand book, McGraw-Hill, New York, USA, 4th edition, 2012.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Open Elective-I**

## 23EEE302 INTRODUCTION TO MEMS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite** 23EEE101

**Course Objectives:**

This course enables students to

1. To provide foundational knowledge on MEMS, its historical development, working principles, and scaling effects.
2. To understand the operation of micro sensors and actuators, and their integration into MEMS structures.
3. To explore MEMS materials and comprehend various microfabrication and micromachining techniques.
4. To develop competency in modeling MEMS devices using simulation methods such as FEM for sensor and actuator behavior.
5. To examine various applications of MEMS in different domains including RF, optical, microfluidic, and robotics systems.

**UNIT I INTRODUCTION** **9 hours**

Overview – History and industry perspectives – Working principles – Mechanics and dynamics Scaling law

**UNIT II MICRO SENSORS & ACTUATORS** **9 hours**

Micro sensors: Pressure sensors, accelerometers, gyroscopes-Micro actuators: comb drive actuators – Micro-electromechanical systems.

**UNIT III MICRO MANUFACTURING** **9 hours**

Materials for MEMS and Microsystems- Micro fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapour Deposition- Physical Vapour Deposition, Micro manufacturing: Bulk micromachining, surface micromachining, LIGA Process- Packaging.

**UNIT IV MODELING IN MEMS** **9 hours**

Micro system design: Finite Element Methods-– Modeling of simulation – piezoelectric, Gyroscope

**UNIT V MEMS APPLICATIONS** **9 hours**

Micro fluids-sensors for turbulence measurement and control, micro-actuators for flow control, RFMEMS- filters, Oscillators and phase shifters, Optical MEMS, micro robotics – Case studies

**Course Outcomes:**

Upon successful completion of the course, students will be able to

CO1: Explain the history, structure, operating principles, and scaling challenges of MEMS – L2

CO2: Describe the working of micro sensors and actuators and their roles in MEMS – L2

CO3: Analyze the materials and various microfabrication techniques used in MEMS manufacturing – L4

CO4: Apply modeling techniques like FEM to simulate MEMS device behavior such as gyroscopes and piezoelectric sensors – L3

CO5: Evaluate MEMS applications in RF, fluidics, optics, and robotics through real-world case studies – L5

**Text Book(s)**

**1.** Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2006

**2.** G.K. Ananthsuresh et al ,'Micro and Smart Systems', Wiley, India, 2010

**Reference Books**

**1.** NadimMaluf, "An introduction to Micro electro mechanical system design", ArtechHouse, 2000

**2.** Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC press Baco Raton, 2000.

**3.** James J.Allen, micro electro mechanical system design, CRC Press published in 2005

**4.** Stephen D. Senturia, Microsystem Design, Kluwer Academic Publishers, 2001

**Mode of Evaluation:** Assignments, Mid Term Tests, End Semester Examination.

**Open Elective – I**

## 23ECE301 BIO-MEDICAL ELECTRONICS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** None

**Course Description:**
This course provides the fundamental knowledge on applications of electronics in bio-medical signal measurements and processing, bio-medical instrumentation and imaging techniques.

**Course Objectives:**
This course enables students to

1. Acquire the basic knowledge on human physiology and biological transducers.
2. Learn about bio-electrodes and bio-amplifiers used in bio-signal acquisition.
3. Understand the working principle of bio-medical measuring instruments.
4. Study various types of imaging techniques used in medicine.
5. Learn the applications of medical instrumentation in designing artificial medical aids

**UNIT I HUMAN PHYSIOLOGY AND BIOMEDICAL TRANSDUCERS 9 hours**

Introduction to human physiology - Biomedical transducers for measuring displacement, velocity, force, acceleration, potential, dissolved ions and gases.

**UNIT II BIO-ELECTRODES AND AMPLIFIERS 9 hours**

Introduction to bio-potential, Bio-electrodes, Typical waveforms and characteristics of ECG, EMG and EEG, Bio-potential amplifiers for ECG, EMG and EEG – Lead systems and recording methods.

**UNIT III BIOMEDICAL MEASURING INSTRUMENTS 9 hours**

Measurement of blood pressure and temperature, Blood flow meter, Cardiac output measurement, Respiratory measurement, Blood cell counter, Impedance plethysmography.

**UNIT IV MEDICAL IMAGING 9 hours**

X-ray, Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Nuclear imaging, Ultrasonic Imaging.

**UNIT V PROSTHESES AND AIDS 9 hours**

Pacemakers, Defibrillators, Heart-lung machine, Artificial kidney, Aids for the handicapped, Safety aspects

**Course Outcomes:**
Upon successful completion of the course, students will be able to

CO1: Understand the applications of biological transducers in medical field.

CO2: Analyze the design of bio-electrodes and bio-amplifiers.

CO3: Apply suitable measuring instruments to measure various medical parameters.

CO4: Understand and test various imaging techniques used in bio-medical diagnosis.

CO5: Analyze the applications of artificial medical aids.

**Text Books:**

**1.** W.F. Ganong, Review of Medical Physiology, 26th Edition, Tata McGraw-Hill, New Delhi, 2019.
**2.** J.G. Websster, ed., Medical Instrumentation, 3rd Edition, Wiley India Pvt. Ltd. 2009

**Reference Books**

**1.** A.M. Cook and J.G. Webster, eds., Medical Devices and Human Engineering, Taylor & Francis, 2014
**2.** R.S.Khandpur,"Handbook of Biomedical Instrumentation", 2nd edition, Tata McGraw - Hill, New Delhi, 2005
**3.** LeslieCromwell,"BiomedicalInstrumentationandMeasurement",Prentice-Hall, New Delhi, 2011.

**Mode of Evaluation:** Assignments, Mid Term Tests, End Semester Examination

**Open Elective – I**

## 23ECE302 VLSI DESIGN

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** None

**Course Description:**
This course describes about various VLSI design methodologies, fundamentals of CMOS technology. It incorporates basics of MOSFET models, CMOS design rules, Design of VLSI Systems, combinational logic design, sequential logic design, logic families and VLSI Design flow.

**Course Objectives:**
This course enables students to

1. Study the fundamentals of CMOS circuits and its characteristics
2. Learn the design and realization of combinational digital circuits.
3. Learn the design and realization of sequential digital circuits.
4. Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed
5. Learn the different FPGA architectures and testability of VLSI circuits.

**UNIT I INTRODUCTION TO MOS TRANSISTOR 9 hours**

MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Charters tics, C-V Charters tics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.

**UNIT II COMBINATIONAL MOS LOGIC CIRCUITS 9 hours**

**Circuit Families:** Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls.
**Power:** Dynamic Power, Static Power, Low Power Architecture.

**UNIT III SEQUENTIAL CIRCUIT DESIGN 9 hours**

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits.
**Timing Issues:** Timing Classification Of Digital System, Synchronous Design.

**UNIT IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM 9 hours**

**Arithmetic Building Blocks:** Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Case Study: Design as a tradeoff.
**Designing Memory and Array structures**: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.

**UNIT V IMPLEMENTATION STRATEGIES AND TESTING 9 hours**

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan

**Course Outcomes:**

Upon successful completion of the course, students will be able to

CO1: Realize the concepts of digital building blocks using MOS transistor.

CO2: Design combinational MOS circuits and power strategies

CO3: Design and construct Sequential Circuits and Timing systems.

CO4: Design arithmetic building blocks and memory subsystems.

CO5: Apply and implement FPGA design flow and testing.

**Text Books:**

**1.** Neil H.E. Weste, David Money Harris "CMOS VLSI Design: A Circuits and Systems Perspective", 4th Edition, Pearson , 2017.

**2.** Jan M. Rabaey ,Anantha Chandrakasan, Borivoje. Nikolic, "Digital Integrated Circuits:A Design perspective", Second Edition , Pearson , 2016.

**Reference Books**

**1.** Operating Systems - Internals and Design Principles. Stallings, 6th Edition2009. Pearson education.

**2.** William Stallings, "Operating Systems – Internals and Design Principles", 7th Edition, Prentice Hall, 2011.

**Mode of Evaluation:** Assignments, Mid Term Tests, End Semester Examination

**Open Elective – 1**

## 23CSE301 JAVA PROGRAMMING

| | | L | T | P | C |
|---|---|---|---|---|---|
| **Pre-requisite** | NIL | **3** | **0** | **0** | **3** |

**Course Objectives:**

The learning objectives of this course are to:

1. Identify Java language components and how they work together in applications.
2. Learn the fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries.
3. Learn how to extend Java classes with inheritance and interfaces in Java applications.
4. Understand how to use Java packages, Exceptions and I/O Streams for program development.
5. Understand how to design applications with threads in Java.
6. Understand how to use Java APIs for program development

**UNIT I** **9 hours**

Object Oriented Programming: Basic concepts, Principles,

Program Structure in Java: Introduction, Writing Simple Java Programs, Elements or Tokens in Java Programs, Java Statements, Command Line Arguments, User Input to Programs, Escape Sequences Comments, Programming Style.

**Data Types**, Variables, and Operators :Introduction, Data Types in Java, Declaration of Variables, Data Types, Type Casting, Scope of Variable Identifier, Literal Constants, Symbolic Constants, Formatted Output with printf() Method, Static Variables and Methods, Attribute Final, **Introduction to Operators**, Precedence and Associativity of Operators, Assignment Operator ( = ), Basic Arithmetic Operators, Increment (++) and Decrement (- -) Operators, Ternary Operator, Relational Operators, Boolean Logical Operators, Bitwise Logical Operators.

**Control Statements**: Introduction, if Expression, Nested if Expressions, if–else Expressions, Ternary Operator?:, Switch Statement, Iteration Statements, while Expression, do–while Loop, for Loop, Nested for Loop, For–Each for Loop, Break Statement, Continue Statement.

**UNIT II** **9 hours**

**Classes and Objects:** Introduction, Class Declaration and Modifiers, Class Members, Declaration of Class Objects, Assigning One Object to Another, Access Control for Class Members, Accessing Private Members of Class, Constructor Methods for Class, Overloaded Constructor Methods, Nested Classes, Final Class and Methods, Passing Arguments by Value and by Reference, this and static Keywords.

**Methods:** Introduction, Defining Methods, Overloaded Methods, Class Objects as Parameters in Methods, Access Control, Recursive Methods, Nesting of Methods

**UNIT III** **9 hours**

**Arrays:** Introduction, Declaration and Initialization of Arrays, Operations on Array Elements, Assigning Array to Another Array, Two-dimensional Arrays, Arrays of Varying Lengths

**Inheritance:** Introduction, Process of Inheritance, Types of Inheritances, Multilevel Inheritance, Application of Keyword Super, Constructor Method and Inheritance, Method Overriding, Dynamic Method Dispatch, Abstract Classes,

**Interfaces:** Introduction, Declaration of Interface, Implementation of Interface, Multiple Interfaces, Nested Interfaces, Inheritance of Interfaces, Default Methods in Interfaces, Static Methods in Interface, Functional Interfaces, Annotations.

**UNIT IV** **9 hours**

**Packages and Java Library:** Introduction, Defining Package, Importing Packages and Classes into Programs, Path and Class Path, Access Control, Packages in Java SE, Java.lang Package and its Classes, Class Object, Enumeration, class Math, Wrapper Classes, Auto-boxing and Auto-unboxing, Java util Classes and Interfaces, Formatter Class, Random Class, Time Package, Class Instant (java.time.Instant), Formatting for Date/Time in Java, Temporal Adjusters Class.

**Exception Handling**: Introduction, Hierarchy of Standard Exception Classes, Keywords throws and throw, try, catch, and finally Blocks, Multiple Catch Clauses, Class Throwable, Unchecked Exceptions, Checked Exceptions.

**UNIT V** **9 hours**

**String Handling in Java:** Introduction, Interface Char Sequence, Class String, Methods for Extracting Characters from Strings, Comparison, Modifying, Searching; Class String Buffer**.**

**Multithreaded Programming:** Introduction, Need for Multiple Threads Multithreaded Programming for Multi-core Processor, Thread Class, Main Thread-Creation of New Threads, Thread States, Thread Priority-Synchronization, Deadlock and Race Situations, Inter-thread Communication - Suspending, Resuming, and Stopping of Threads.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

CO1: Analyze problems, design solutions using OOP principles, and implement them efficiently in Java.

CO2: Design and implement classes to model real-world entities, with a focus on attributes, behaviours, and relationships between objects.

CO3: Demonstrate an understanding of inheritance hierarchies and polymorphic behaviour, including method overriding and interface concept.

CO4: Apply Competence in handling exceptions and errors to write robust and fault-tolerant code.

CO5: Develop multithreaded applications with synchronization.

**Text Books:**

1. JAVA one step ahead, Anitha Seth, B.L.Juneja, Oxford.
2. Joy with JAVA, Fundamentals of Object Oriented Programming, DebasisSamanta, MonalisaSarma, Cambridge, 2023.

**Reference Books:**

1. The complete Reference Java, 11thedition, Herbert Schildt,TMH
2. Introduction to Java programming, 7th Edition, Y Daniel Liang, Pearson
3. JAVA for Programmers, Paul Deitel, Harvey Deitel, 4th Edition, Pearson.

**Online Resources:**

1. https://nptel.ac.in/courses/106/105/106105191/
2. https://infyspringboard.onwingspan.com/web/en/app/toc/lex_auth_012880464547618816347_shared/overview

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Open Elective - I**

**23CST301 OPERATING SYSTEMS** **L T P C**
**3 0 0 3**

**Pre-requisite NIL**

**Course Description:**

This course introduces the fundamental concepts and principles of operating systems, covering process and thread management, CPU scheduling, synchronization, deadlocks, memory management, file systems, and system protection mechanisms. Students will gain practical understanding of how modern operating systems function, focusing on process coordination, resource allocation, and system-level design. Through theoretical insights and hands-on exposure, learners will be equipped to analyze, design, and optimize OS components for better performance and reliability in computing systems.

**Course Objectives:**

The main objectives of the course is to make student

1. Understand the basic concepts and principles of operating systems, including process management, memory management, file systems, and Protection
2. Make use of process scheduling algorithms and synchronization techniques to achieve better performance of a computer system.
3. Illustrate different conditions for deadlock and their possible solutions.

**UNIT I OPERATING SYSTEMS OVERVIEW 9 hours**

**Operating Systems Overview:** Introduction, Operating system functions, Operating systems operations, Computing environments, Free and Open-Source Operating Systems **System Structures:** Operating System Services, User and Operating-System Interface, system calls, Types of System Calls, system programs, Operating system Design and Implementation, Operating system structure, Building and Booting an Operating System, Operating system debugging

**UNIT II PROCESS AND THREADS 9 hours**

**Processes:** Process Concept, Process scheduling, Operations on processes, Inter-process communication. **Threads and Concurrency:** Multithreading models, Thread libraries, Threading issues. **CPU Scheduling:** Basic concepts, Scheduling criteria, Scheduling algorithms, Multiple processor scheduling.

**UNIT III SYNCHRONIZATION 9 hours**

**Synchronization Tools:** The Critical Section Problem, Peterson‘s Solution, Mutex Locks, Semaphores, Monitors, Classic problems of Synchronization. **Deadlocks:** system Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from Deadlock.

**UNIT IV MEMORY MANAGEMENT 9 hours**

**Memory- Management Strategies:** Introduction, Contiguous memory allocation, Paging, Structure of the Page Table, Swapping. **Virtual Memory Management:** Introduction, Demand paging, Copy-on-write, Page replacement, Allocation of frames, Thrashing. **Storage Management:** Overview of Mass Storage Structure, HDD Scheduling.

**UNIT V FILE SYSTEM 9 hours**

**File System:** File System Interface: File concept, Access methods, Directory Structure; File system Implementation: File-system structure, File-system Operations, Directory implementation, Allocation method, Free space management; File-System Internals: File System Mounting, Partitions and Mounting, File Sharing. **Protection:** Goals of protection, Principles of protection, Protection Rings,

Domain of protection, Access matrix.

**Course Outcomes:**

After completion of the course, students will be able to

CO1: Describe the basics of the operating systems, mechanisms of OS to handle processes, threads, and their communication.

CO2: Understand the basic concepts and principles of operating systems, including process management, memory management, file systems, and Protection.

CO3: Make use of process scheduling algorithms and synchronization techniques to achieve better performance of a computer system.

CO4: Illustrate different conditions for deadlock and their possible solutions.

CO5: Able to design and implement file systems, focusing on file access methods, directory structure, free space management, and also explore various protection mechanisms.

**Text Book(s)**

1. Operating System Concepts, Silber schatz A, Galvin P B, Gagne G, 10th Edition, Wiley, 2018.

2. Modern Operating Systems, Tanenbaum A S, 4th Edition, Pearson , 2016

**Reference Books**

1. Operating Systems -Internals and Design Principles, Stallings W, 9th edition, Pearson, 2018

2. Operating Systems: A Concept Based Approach, D.M Dhamdhere, 3rd Edition, McGraw- Hill, 2013

**Mode of Evaluation:** Assignments, Mid Term Tests, End Semester Examination.

**Open Elective – I**

## 23CAI301 MOBILE COMPUTING

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** **None**

**Course Objectives:**

The main objectives of the course is to

1. To understand the basic concepts of mobile computing.
2. To learn the basics of mobile telecommunication system.
3. To be familiar with the network layer protocols and Ad-Hoc networks.
4. To know the basis of transport and application layer protocols.
5. To gain knowledge about different mobile platforms and application development.

**UNIT I INTRODUCTION** **9 hours**

Introduction to Mobile Computing – Applications of Mobile Computing- Generations of Mobile Communication Technologies- Multiplexing – Spread spectrum -MAC Protocols – SDMA- TDMA- FDMA- CDMA

**UNIT II MOBILE TELECOMMUNICATION SYSTEM** **9 hours**

Introduction to Cellular Systems - GSM – Services & Architecture – Protocols – Connection Establishment – Frequency Allocation – Routing – Mobility Management – Security – GPRS- UMTS – Architecture – Handover - Security

**UNIT III MOBILE NETWORK LAYER** **9 hours**

Mobile IP – DHCP – AdHoc– Proactive protocol-DSDV, Reactive Routing Protocols – DSR, AODV, Hybrid routing –ZRP, Multicast Routing- ODMRP, Vehicular Ad Hoc networks (VANET) –MANET Vs VANET – Security.

**UNIT IV MOBILE TRANSPORT AND APPLICATION LAYER** **9 hours**

Mobile TCP– WAP – Architecture – WDP – WTLS – WTP –WSP – WAE – WTA Architecture – WML

**UNIT V MOBILE PLATFORMS AND APPLICATIONS** **9 hours**

Mobile Device Operating Systems – Special Constraints & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – MCommerce – Structure – Pros & Cons – Mobile Payment System – Security Issues

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

CO1: Explain the basics of mobile telecommunication systems

CO2: Illustrate the generations of telecommunication systems in wireless networks

CO3: Determine the functionality of MAC, network layer and Identify a routing protocol for a given Ad hoc network

CO4: Explain the functionality of Transport and Application layers

CO5: Develop a mobile application using android/blackberry/ios/Windows SDK

**Text Books:**

**1.** Jochen Schiller, Mobile Communications, Addison-Wesley, Second Edition, 2009.

**2.** Prasant Kumar Pattnaik, Rajib Mall, “Fundamentals of Mobile Computing”, PHI Learning Pvt.Ltd, New Delhi – 2012

**Reference Books:**

**1.** Dharma Prakash Agarval, Qing and an Zeng, "Introduction to Wireless and Mobile systems",Thomson Asia Pvt Ltd, 2005.

**2.** Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, “Principles of Mobile Computing”, Springer, 2003.

**3.** Windows Phone DevCenter : http://developer.windowsphone.com

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Open Elective - I**

## 23CSD301 INTRODUCTION TO DATA SCIENCE

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** **None**

**Course Objectives:**

The main objectives of the course is to

1. Knowledge and expertise to become a data scientist.
2. Essential concepts of statistics and machine learning that are vital for data science;
3. Significance of exploratory data analysis (EDA) in data science.
4. Critically evaluate data visualizations presented on the dashboards
5. Suitability and limitations of tools and techniques related to data science process

**UNIT I** **9 hours**

Introduction to Data science, benefits and uses, facets of data, data science process in brief, big data ecosystem and data science.

**Data Science process:** Overview, defining goals and creating project charter, retrieving data, cleansing, integrating and transforming data, exploratory analysis, model building, presenting findings and building applications on top of them.

**UNIT II** **9 hours**

Applications of machine learning in Data science, role of ML in DS, Python tools like sklearn, modelling process for feature engineering, model selection, validation and prediction, types of ML, semi-supervised learning

**Handling large data:** problems and general techniques for handling large data, programming tips for dealing large data, case studies on DS projects for predicting malicious URLs, for building recommender systems

**UNIT III** **9 hours**

**NoSQL movement for handling Bigdata:** Distributing data storage and processing with Hadoop framework, case study on risk assessment for loan sanctioning, ACID principle of relational databases, CAP theorem, base principle of NoSQL databases, types of NoSQL databases, case study on disease diagnosis and profiling.

**UNIT IV** **9 hours**

**Tools and Applications of Data Science:** Introducing **Neo4j**for dealing with graph databases, graph query language **Cypher**, Applications graph databases, Python libraries like nltk and SQLite for handling Text mining and analytics, case study on classifying Reddit posts.

**UNIT V** **9 hours**

**Data Visualization and Prototype Application Development:** Data Visualization options, Crossfilter, the JavaScript MapReduce library, Creating an interactive dashboard with dc.js, Dashboard development tools.

Applying the Data Science process for real world problem solving scenarios as a detailed case study.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to
CO1: Understand the fundamental concepts and applications of data science.
CO2: Apply machine learning techniques to solve data science problems.
CO3: Compare and contrast relational and NoSQL databases.
CO4: Utilize graph databases for data analysis.
CO5: Create interactive data visualizations.

**Text Books:**

**1.** Davy Cielen, Arno D.B.Meysman, and Mohamed Ali, "Introducing to Data Science using Python tools", Manning Publications Co, Dreamtech press, 2016

**2.** Prateek Gupta, "Data Science with Jupyter" BPB publishers, 2019 for basics

**Reference Books:**

**1.** Joel Grus, "Data Science From Scratch", OReilly, 2019

**2.** Doing Data Science: Straight Talk From The Frontline, 1 st Edition, Cathy O'Neil and Rachel Schutt, O'Reilly, 2013

**Online Learning Resources**

**1.** https://www.coursera.org/specializations/introduction-data-science

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Open Elective - I**

## 23CSM301 AI FOR EVERYONE

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite: NIL**

**Course Objectives:**

The objectives of the course are to

1. Understand the basics of artificial intelligence and its subfields.
2. Explore real-world applications of AI across different industries.
3. Gain insights into the ethical, social, and economic implications of AI.
4. Develop an appreciation for the potential of AI to drive innovation and transformation.

**UNIT I INTRODUCTION** **9 hours**

Introduction to Artificial Intelligence (AI): Significance, Historical Overview & Evolution, Artificial Intelligence: Types, Applications, Challenges & Opportunities, Introduction to Intelligent Agents, Branches of AI: Machine Learning, NLP, Robotics, Expert Systems, Deep Learning: Concept of Neural Networks, AI vs Human Intelligence.

**UNIT II APPLICATIONS OF AI** **9 hours**

AI in Everyday Life: Smart Assistants, Chatbots, Recommendation Systems, AI in Engineering: Robotics, Predictive Maintenance, AI in Healthcare, Education, Agriculture, Transport, Real-World AI Systems: Google Maps, Siri, Amazon, Tesla.

**UNIT III PROBLEM SOLVING AND CASE STUDIES** **9 hours**

How AI Solves Problems: Search, Logic, Pattern Recognition, Introduction to Rule-Based Systems. Case Studies: Smart Speaker, Self-Driving Car, AI in Climate Monitoring, AI in Disaster Response Example Roles of an AI Team, Survey of Major AI Application Areas.

**UNIT IV AI AND SOCIETY** **9 hours**

Impact of AI on Jobs and Employment, AI in Governance and Public Services, Human-AI Collaboration: Assistive AI, Digital Divide and Accessibility Challenges, AI in Developing Countries – Opportunities and Challenges, Case Studies on Social Applications.

**UNIT V ETHICAL AND SOCIAL IMPLICATIONS OF AI** **9 hours**

Bias And Fairness in AI Systems, Privacy and Data Protection Concerns, Responsible AI: Policies and Frameworks, AI and Social inequality, Ethical Guidelines and Responsible AI Practices, AI and Innovation, Emerging Trends and Future Directions in AI, AI and Creativity: Generative Models and Artistic Applications

**Course Outcomes:**

At the end of this course students will be able to

CO1: Apply basic AI concepts and identify different types and branches of AI.
CO2: Analyze how AI is used in real-life applications across various fields.
CO3: Apply AI techniques to understand how problems are solved using real-world case studies.
CO4: Analyze the impact of AI on jobs, governance, and social development.
CO5: Analyze ethical issues in AI and understand the importance of responsible AI practices.

**Text Books:**

1. "Artificial Intelligence A Guide for Thinking Humans", Melanie Mitchell .
2. "Artificial Intelligence: The Basics", Kevin Warwick, Routledge, 2011.

**Reference Books:**

1. "AI for Everyone: The Essential Guide", Dale Lane, Wiley, 2021.
2. "Artificial Intelligence Basics: A Non-Technical Introduction", Tom Taulli, Apress, 2019

**Mode of Evaluation:** Assignments, Mid Term Tests, End Semester Examination.

# PROFESSIONAL ELECTIVES

**Professional Elective – II**

## 23ME401 REFRIGERATION AND AIR CONDITIONING

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** **23ME103 Thermodynamics**

**Course Objectives:**

This course is designed to:

1. Understand the fundamental concepts, performance metrics, and cycle analysis of vapour compression refrigeration systems.
2. Study the functional components of VCR systems and the selection criteria of refrigerants based on thermophysical and environmental properties.
3. Explore the working principles and applications of vapour absorption and alternative refrigeration systems.
4. Introduce psychrometric concepts, heat load analysis, and various air conditioning configurations.
5. Learn about air conditioning components and human thermal comfort requirements for effective HVAC design.

### UNIT I INTRODUCTION TO REFRIGERATION AND VCR SYSTEM 9 hours

Introduction to Refrigeration, Necessity and Applications, Unit of Refrigeration, COP, EER, Methods of refrigeration.

**Vapour compression refrigeration system:** Working principle, effect of sub cooling and super heating, ideal and actual cycle, multi-stage, cascading VCR systems, numerical problems.

### UNIT II COMPONENTS OF VCR SYSTEM AND REFRIGERANTS 9 hours

**Vapour Compression Refrigeration System Components**: General classification of compressors, condensers, evaporators and expansion devices and working principles.

**Refrigerants:** Desirable properties, Classification of refrigerants, Nomenclature, Environmental impact.

### UNIT III VAR SYSTEM AND OTHER REFRIGERATION SYSTEMS 9 hours

**Vapour Absorption Refrigeration system:** Introduction to Vapour absorption refrigeration system, Lithium-Bromide absorption refrigeration system, three fluid absorption refrigeration system and comparison of compression and absorption refrigeration systems.

**Other Refrigeration systems:** Working principles of Steam jet refrigeration system, Thermoelectric refrigeration system, Solar refrigeration system, Vortex & Pulse tube refrigeration system.

### UNIT IV INTRODUCTION TO AIR CONDITIONING SYSTEMS 9 hours

Psychrometric Properties & Processes, Characterization of Sensible and Latent Heat Loads, Need for Ventilation, Consideration of Infiltrated Air, Heat Load Concepts.

**Air Conditioning Systems:** Air Cooler (Evaporative Cooling), Window, Split, Summer, Winter, Year-Round, Central Air Conditioning Systems.

**UNIT V AIR CONDITIONING EQUIPMENT 9 hours**

Air Conditioning Equipment: Humidifiers, Dehumidifiers, Air Filters, Fans and Blowers. Inverter Technology in Air conditioners.

**Human Comfort:** Requirements of Temperature, Humidity and Concept of Effective Temperature, Comfort Chart. Heat Pump, Heat Sources, Different Heat Pump Circuits.

**Course Outcomes:**

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

CO1: Apply thermodynamic principles to evaluate the performance of vapor compression refrigeration systems including subcooling and superheating effects. (L3)

CO2: Explain the function and classification of VCR components and identify suitable refrigerants based on their properties and environmental impact. (L2)

CO3: Analyze and compare vapour absorption refrigeration systems with alternative refrigeration technologies for specific applications. (L4)

CO4: Apply psychrometric principles to assess heat loads and select appropriate air conditioning systems for various climate conditions. (L3)

CO5: Describe the role of air conditioning equipment and heat pump systems in achieving indoor human comfort conditions. (L2)

**Text Books:**

1. Arora, C. P. (2020). Refrigeration and air conditioning (4th ed.). McGraw Hill Education.
2. Domkundwar, S. C., Arora, A., & Domkundwar, V. M. (2021). A course in refrigeration and air conditioning (Revised ed.). Dhanpat Rai & Co.
3. Ballaney, P. L. (2023). Refrigeration and air conditioning (Revised ed.). Khanna Publishers.

**Reference Books:**

1. Stoecker, W. F., & Jones, J. W. (2020). Refrigeration and air conditioning (2nd ed.). McGraw Hill Education.
2. Dossat, R. J., & Horan, T. J. (2019). Principles of refrigeration (5th ed.). Pearson Education.
3. Threlkeld, J. L. (2018). Thermal environmental engineering (3rd ed.). Pearson Education.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Professional Elective – II**

## 23ME402 RENEWABLE ENERGY SYSTEMS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** **None**

**Course Objectives:**

This course is designed to:

1. Provide an overview of the current global and national energy scenario and highlight the importance of transitioning to renewable energy sources.
2. Introduce the fundamental concepts, technologies, and applications of solar and biomass energy systems.
3. Develop a sound understanding of wind energy principles, system components, and their integration with micro/mini hydropower technologies.
4. Expose students to clean energy alternatives like hydrogen energy and fuel cells, focusing on their production, storage, and environmental aspects.
5. Familiarize students with other renewable energy technologies such as geothermal, tidal, wave, and ocean thermal systems, and their role in sustainable energy development.

### UNIT I INTRODUCTION TO RENEWABLE ENERGY 9 hours

Energy scenario global and Indian context, Environmental aspects of energy conversion, Need for renewable energy sources, Energy resource availability, Forms and characteristics of renewable energy sources, Energy classification, Source and utilization, Patterns of energy supply, National security aspects of energy consumption, Thermodynamic power cycles and binary cycles.

### UNIT II SOLAR ENERGY & BIOMASS ENERGY 9 hours

Solar radiation, flat plate collectors, solar concentration, thermal applications of solar energy, Solar photovoltaic (PV) systems working principle, types of PV cells, Solar energy applications. Biomass resources and classification Thermo-chemical and biochemical conversion combustion, gasification, pyrolysis, anaerobic digestion, bioethanol and biodiesel production and utilization.

### UNIT III WIND ENERGY 9 hours

Wind characteristics, resource assessment, horizontal and vertical axis wind turbines, electricity generation and water pumping, Micro/Mini hydropower system, water pumping and conversion to electricity, hydraulic pump.

### UNIT IV CLEAN ENERGY SOURCES 9 hours

Hydrogen: properties, production methods electrolysis, reforming, biomass routes, Storage and transportation of hydrogen, safety and environmental impacts of hydrogen, Introduction to Fuel cell Technology, Fuel cell types - PEMFC, SOFC, etc., working principles, efficiency.

### UNIT V OTHER RENEWABLE SOURCES 9 hours

Geothermal energy, tidal, wave, ocean thermal energy conversion (OTEC), MHD, environmental issues of energy sources.

**Course Outcomes:**

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

CO1: Explain the energy scenario in the global and Indian context and summarize the need, availability, and classification of renewable energy sources. (L2)

CO2: Apply the working principles of solar thermal and photovoltaic systems and compare different biomass energy conversion technologies. (L3)

CO3: Illustrate wind energy system components and analyze resource assessment methods and micro/mini hydropower generation techniques. (L3)

CO4: Analyze hydrogen production processes and evaluate fuel cell types based on efficiency and application suitability. (L4)

CO5: Describe the basic principles of geothermal, tidal, wave, and ocean thermal energy systems and discuss their environmental implications. (L2)

**Text Books:**

1. Kothari, D. P., Singal, K. C., & Ranjan, R. (2020). Renewable energy sources and emerging technologies (3rd ed.). PHI Learning.
2. Boyle, G. (2021). Renewable energy: Power for a sustainable future (4th ed.). Oxford University Press.
3. Twidell, J., & Weir, T. (2021). Renewable energy resources (4th ed.). Routledge.

**Reference Books:**

1. Kalogirou, S. A. (2022). Solar energy engineering: Processes and systems (3rd ed.). Academic Press.
2. Lund, H. (2021). Renewable energy systems: A smart energy systems approach (4th ed.). Academic Press.
3. Duffie, J. A., & Beckman, W. A. (2020). Solar engineering of thermal processes (5th ed.). Wiley.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Professional Elective – II**

## 23ME403 NON DESTRUCTIVE TESTING

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** **None**

**Course Objectives:**

This course is designed to:

1. Introduce the principles and procedures of surface-based non-destructive testing methods such as liquid penetrant and magnetic particle testing.
2. Impart fundamental knowledge on thermography and eddy current techniques used in detecting subsurface defects.
3. Familiarize students with ultrasonic testing methods, scan types, and relevant industry inspection standards.
4. Provide insights into radiographic testing techniques, safety measures, and interpretation of radiographic images.
5. Explore advanced non-destructive evaluation techniques and recent developments in structural health monitoring.

**UNIT I SURFACE NON-DESTRUCTIVE EVALUATION TECHNIQUES 9 hours**

Overview of the Non-Destructive Testing Methods for the detection of manufacturing defects. Liquid Penetrant Testing – Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing-Theory of magnetism, inspection materials, Magnetization methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

**UNIT II THERMOGRAPHY AND EDDY CURRENT TESTING (ET) 9 hours**

Thermography- Principles, Contact and non-contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation – infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

**UNIT III ULTRASONIC TESTING 9 hours**

Fundamentals of ultrasonic waves, Generation of ultrasonic waves-piezo electric effect, Ultrasonic inspection methods-pulse echo method, through transmission method, resonance method, Study of A, B and C scan presentations, Interpretation for welds, castings etc., applications, various case studies, Inspection standards and specifications (ASME, ASTM, AWS, BS, IBR etc.)

**UNIT IV RADIOGRAPHIC TESTING AND SAFETY 9 hours**

Basic principles of radiography- X rays and their properties, X ray generation, X ray absorption and scattering, Radiographic image-image formation and quality, image interpretation, radiography of weldments, Radiation safety - radiation detectors, radiation shielding. Interpretation for welds, castings etc, applications, various case studies, Inspection standards and specifications (ASME, ASTM, AWS, BS, IBR etc.)

**UNIT V ADVANCED NDE TECHNIQUES 9 hours**

Acoustic emission testing: Basic principle, parameters, Kaiser-Felicity theory Phased array techniques- Principles of phased array inspection, Theory and principles of time-of-flight diffraction (TOFD), Synthetic Aperture Focusing Technique (SAFT), Electro Magnetic Acoustic Transducer (EMAT), Laser ultrasonics - Laser Shearographics, Structural health monitoring, Digital Radiography, Computed Tomography (CT).

**Course Outcomes:**

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

CO1: Explain the working principles, procedures, and applications of surface non-destructive testing methods including LPT and MPT. (L2)

CO2: Apply thermography and eddy current testing techniques to identify and interpret flaws in engineering materials and components. (L3)

CO3: Analyze ultrasonic testing data using A, B, and C scans to evaluate material integrity as per industry standards. (L4)

CO4: Evaluate radiographic images and implement safety protocols while interpreting defects in castings and welds. (L4)

CO5: Describe and apply advanced NDE techniques such as phased array, TOFD, EMAT, and CT for complex component evaluation. (L3)

**Text Books:**

1. Rao, B. (2020). Non-destructive testing (3rd ed.). McGraw Hill Education.
2. Sharma, B. D. (2021). Non-destructive testing and evaluation of materials. Khanna Publishers.
3. Prasad, J., & Jayakumar, T. (2021). Non-destructive test and evaluation of materials (3rd ed.). Tata McGraw Hill.

**Reference Books:**

1. Hellier, C. J. (2020). Handbook of nondestructive evaluation (2nd ed.). McGraw Hill.
2. Maldague, X. (2019). Theory and practice of infrared technology for nondestructive testing (2nd ed.). Wiley.
3. Bray, D. E., & Stanley, R. K. (2018). Nondestructive evaluation: A tool in design, manufacturing, and service (2nd ed.). CRC Press.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Professional Elective – II**

## 23ME404 INTRODUCTION TO COMPOSITES

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** None

**Course Objectives:**

This course is designed to:

1. Introduce the fundamental concepts of composite materials, including their classification, reinforcement, matrices, and their advantages over conventional materials.
2. Familiarize students with various processing techniques for polymer matrix composites, including thermoset and thermoplastic methods and their applications.
3. Provide an understanding of metal matrix composites (MMCs), their constituent materials, fabrication techniques, and interface characteristics.
4. Explain the processing and characteristics of ceramic matrix composites (CMCs), including advanced manufacturing techniques and interfacial behaviour.
5. Explore recent advancements in composite materials and expose students to testing methods and challenges associated with their machining and joining.

**UNIT I INTRODUCTION** **9 hours**

Introduction to Composites; Reinforcement and matrices; Types of reinforcements; Types of matrices; Classifications of composites; Role of Matrix and Reinforcement in Composites Matrices; Properties of composites in comparison with standard materials; applications of composites (metal, ceramics, and polymer matrix composites), Advantages and Limitations.

**UNIT II PROCESSING OF POLYMER MATRIX COMPOSITES** **9 hours**

Thermoset matrix composites: hand layup, spray, filament winding, Pultrusion, resin transfer moulding, autoclave moulding - bag moulding, compression moulding – thermoplastic matrix composites – film stacking, diaphragm forming, thermoplastic tape laying, injection moulding – interfaces in PMCs – structure, properties and application of PMCs.

**UNIT III PROCESSING OF METAL MATRIX COMPOSITES** **9 hours**

Metallic matrices: aluminium, titanium, magnesium, copper – processing of MMCs: liquid state, solid state, in – situ fabrication techniques – diffusion bonding – powder metallurgy techniques – Interfaces in MMCs – structure, properties and application of MMCs.

**UNIT IV PROCESSING OF CERAMIC MATRIX COMPOSITES** **9 hours**

Processing of CMCs: cold pressing, sintering, reaction bonding, liquid infiltration, lanxide process – in situ chemical reaction techniques, chemical vapour deposition, chemical vapour impregnation, sol-gel – interfaces in CMCs – structure, properties and application of CMCs.

**UNIT V RECENT DEVELOPMENTS IN COMPOSITES & TESTING OF COMPOSITES** **9 hours**

Self-healing composites, Molecular composites, Micro and Nanocomposites, Bio composites and Natural Inspired materials.

Testing of composites - tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, wear, thermal conductivity etc., Challenges in Machining of Composites – PMC & MMC, Joining of Composites. Challenges in Additive Manufacturing of Composites.

**Course Outcomes:**

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

CO1: Identify and classify different types of composite materials and explain the roles of matrices and reinforcements in their structure and applications. (L2)

CO2: Describe and compare the manufacturing techniques of polymer matrix composites and analyze their structures and performance in various applications. (L3)

CO3: Select suitable metallic matrices and justify appropriate processing methods for metal matrix composites, considering their structure-property relationships. (L3)

CO4: Explain the advanced fabrication methods of ceramic matrix composites and evaluate their interfacial characteristics and suitability for applications. (L3)

CO5: Analyze recent trends and innovations in composite materials, and demonstrate testing methods to evaluate mechanical and thermal properties of composites. (L4)

**Text Books:**

1. Chawla, K. K. (2019). Composite materials: Science and engineering (3rd ed.). Springer.
2. Mallick, P. K. (2021). Fiber-reinforced composites: Materials, manufacturing, and design (4th ed.). CRC Press.
3. Agarwal, B. D., Broutman, L. J., & Chandrashekhara, K. (2018). Analysis and performance of fiber composites (4th ed.). Wiley.

**Reference Books:**

1. Gibson, R. F. (2021). Principles of composite material mechanics (4th ed.). CRC Press.
2. Strong, A. B. (2020). Fundamentals of composites manufacturing: Materials, methods and applications (2nd ed.). SME.
3. Miracle, D. B., & Donaldson, S. L. (Eds.). (2020). ASM handbook, Volume 21: Composites (2nd ed.). ASM International.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Professional Elective – III**

## 23ME405 OPERATIONS RESEARCH

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** **None**

**Course Objectives:**

This course is designed to:

1. Introduce the fundamentals of Operations Research and the process of developing mathematical models for decision-making.
2. Equip students with optimization techniques such as Linear Programming and understand their applications in real-life scenarios.
3. Impart knowledge on solving transportation and assignment problems for optimal resource allocation.
4. Familiarize students with inventory and queuing models for managing supply chains and service systems efficiently.
5. Develop competence in project scheduling, sequencing, and network analysis techniques for operations planning.

### UNIT I INTRODUCTION TO OPERATIONS RESEARCH 9 hours

Introduction to Operations Research (OR): OR definition, Classification of Models, modeling – Methods of solving OR Models, limitations and applications of OR models. Linear Programming (LP): Problem Formulation, Graphical Method, Simplex Method, Big-M Method, Two–Phase Simplex Method, Special Cases of LP.

### UNIT II TRANSPORTATION MODELS 9 hours

Introduction to Transportation Problem, Different Methods of Obtaining Initial Basic Feasible Solution – Northwest Corner Rule, Least Cost Method, Vogel's Approximation Method; Optimality Method – Modified Distribution (MODI) Method; Special Cases – Unbalanced Transportation Problem, Degenerate Problem. Assignment Problem – Formulation, Hungarian Method for Solving Assignment Problems, Traveling Salesman problem.

### UNIT III INVENTORY CONTROL MODELS 9 hours

Economic order quantity (EOQ) model with and without shortages, Finite replenishment rate Inventory models without and with planned shortages. Determination of reorder point, Quantity discount models.

### UNIT IV QUEUING THEORY 9 hours

Introduction to Queuing Theory, Arrival Pattern, Service Channel, Population, Departure Pattern, Queue Discipline, Birth & Death Process, Single Channel Models with Poisson Arrivals, Exponential Service Times with finite queue length and non-finite queue length; Multichannel Models with Poisson Arrivals, Exponential Service Times with finite queue length and non-finite queue length.

### UNIT V SEQUENCING and PROJECT MANAGEMENT 9 hours

Sequencing problem: n jobs on 2 machines – n jobs on 3 machines – two jobs on m machines– n jobs on m machines, Network analysis- precedence diagram and PERT - expected time - optimistic time estimate - most likely time - pessimistic time CPM: Basic Difference between PERT and CPM, PERT / CPM Network Components and Precedence Relationship, Scheduling - Johnson's rule – Gantt charts- FCFS-SPT-LPT-EDD techniques.

**Course Outcomes:**

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

CO1: Apply the concepts of operations research to formulate and solve Linear Programming problems using graphical and simplex-based methods. (L3)

CO2: Analyze transportation and assignment models using optimal solution techniques like MODI and Hungarian methods to achieve cost-effective operations. (L4)

CO3: Apply EOQ models and inventory control strategies to determine optimal order quantities and reorder points under various supply conditions. (L3)

CO4: Explain the basic structure and functioning of queuing models and interpret the behaviour of service systems with single and multi-channel configurations. (L2)

CO5: Evaluate project schedules using sequencing rules, PERT/CPM techniques, and decision rules like FCFS, SPT, and Johnson's Rule to enhance time management and resource utilization. (L4)

**Text Books:**

1. Taha, H. A. (2023). *Operations research: An introduction* (11th ed.). Pearson Education.
2. Sharma, J. K. (2022). *Operations research: Theory and applications* (6th ed.). Macmillan India.
3. Panneerselvam, R. (2021). *Operations research* (3rd ed.). PHI Learning.

**Reference Books:**

1. Hillier, F. S., & Lieberman, G. J. (2020). *Introduction to operations research* (10th ed.). McGraw Hill Education.
2. Ravindran, A., Phillips, D. T., & Solberg, J. J. (2021). *Operations research: Principles and practice* (2nd ed.). Wiley India.
3. Tulsian, P. C., & Pandey, V. (2022). *Quantitative techniques: Theory and problems* (2nd ed.). Pearson Education.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Professional Elective – III**

## 23ME406 AUTOMATION AND ROBOTICS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** **None**

**Course Objectives:**

This course is designed to:

1. Introduce the fundamentals of industrial automation, its necessity, types, and components involved in discrete and continuous control systems.
2. Provide knowledge of automated flow lines and assembly systems, including quantitative methods for evaluating performance and optimizing assembly lines.
3. Familiarize students with industrial robots, their configurations, components, actuators, and sensors used in automation systems.
4. Develop understanding of robotic kinematics and dynamics, and equip students with the tools for trajectory planning and obstacle avoidance.
5. Expose students to robot programming techniques and various industrial applications.

**UNIT I FUNDAMENTALS OF INDUSTRIAL AUTOMATION 9 hours**

Introduction to Automation, Need, Types, Basic elements of an automated system, levels of automation, Continuous vs Discrete Industrial Control systems, Hardware components for automation and process control, mechanical feeders, hoppers, orienters, high speed automatic insertion devices.

**UNIT II AUTOMATED FLOW LINES AND ASSEMBLY LINE ANALYSIS 9 hours**

Automated flow lines, Part transfer methods and mechanisms, types of Flow lines, flow line with/without buffer storage, Quantitative analysis of flow lines. Assembly line balancing: Assembly process and systems, assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

**UNIT III INDUSTRIAL ROBOTS AND COMPONENTS 9 hours**

Introduction to Industrial Robots, Classification of Robot Configurations, functional line diagram, degrees of freedom. Components: common types of arms, joints, grippers, factors to be considered in the design of grippers. Robot actuators and Feedback components: Actuators, Pneumatic, Hydraulic actuators, Electric & Stepper motors, comparison. Position sensors - potentiometers, resolvers, encoders - velocity sensors, Tactile sensors, Proximity sensors.

**UNIT IV ROBOT KINEMATICS, DYNAMICS, AND TRAJECTORY PLANNING 9 hours**

Manipulator Kinematics: Homogenous transformations as applicable to rotation and translation- D-H notation, Forward/inverse kinematics.

Manipulator Dynamics: Differential transformations, Jacobians, Lagrange - Euler and Newton – Euler formations. Trajectory Planning: Trajectory Planning and avoidance of obstacles path planning, skew motion, joint integrated motion - straight line motion.

**UNIT V ROBOT PROGRAMMING AND APPLICATIONS 9 hours**

Robot Programming, Methods of programming - requirements and features of programming languages, software packages. Problems with programming languages. Robot Application in Engineering: Robotic welding, assembly, painting, material handling, CNC operations, PCB soldering, microchip handling, testing and inspection automation, Robotic 3D printing, bricklaying, structural inspection, AI-driven

robotic control, autonomous navigation, robotic vision, Surgical robots, rehabilitation devices, space robots.

**Course Outcomes:**

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

CO1: Identify the types and components of industrial automation systems and differentiate between continuous and discrete control systems. (L2)

CO2: Apply line balancing techniques and analyze the performance of automated flow lines with and without buffer storage. (L3)

CO3: Classify industrial robot configurations and explain the working of various robot components and sensors. (L2)

CO4: Solve forward and inverse kinematics problems and analyze robot dynamics for trajectory planning. (L4)

CO5: Demonstrate robot programming methods and examine their applications in various engineering applications. (L3)

**Text Books:**

1. Groover, M. P. (2022). Automation, production systems, and computer-integrated manufacturing (5th ed.). Pearson Education.
2. Craig, J. J. (2022). Introduction to robotics: Mechanics and control (4th ed.). Pearson Education.
3. Groover, M. P., & Weiss, M. (2020). Industrial robotics: Technology, programming, and applications (2nd ed.). McGraw Hill.

**Reference Books:**

1. Spong, M. W., Hutchinson, S., & Vidyasagar, M. (2020). Robot modeling and control (2nd ed.). Wiley.
2. Deb, S. R. (2021). Robotics technology and flexible automation (2nd ed.). McGraw Hill Education.
3. Koren, Y. (2019). Robotics for engineers. McGraw Hill Education.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Professional Elective – III**

## 23ME407 FINITE ELEMENT METHODS

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** **None**

**Course Objectives:**

This course is designed to:

1. Introduce the fundamentals of Finite Element Method and its application to structural and mechanical systems.
2. Formulate and solve one-dimensional FEM problems including axial bars, trusses, and beams.
3. Develop understanding of two-dimensional element formulations using triangular and quadrilateral elements.
4. Impart knowledge on dynamic analysis using FEM and determine natural frequencies and mode shapes.
5. Apply FEM principles to analyze problems in heat transfer and fluid mechanics.

### UNIT I INTRODUCTION TO FEM 9 hours

Introduction to FEM, engineering applications, advantages, General steps, Element types, Convergence criteria, Coordinate systems, commercial packages preprocessor, solver and post processor. Principles of Elasticity: Strain displacement relations, Stress strain relations for 1D, 2D, and 3D cases, Plain stress and Plain strain conditions, Introduction to Numerical Methods, Potential energy method, Rayleigh Ritz method and Galerkin method applied to simple problems on axially loaded members, cantilever, simply supported beams, with point loads and distributed loads.

### UNIT II ONE DIMENSIONAL PROBLEMS 9 hours

Formulation of a linear bar element, Shape Functions Polynomial, The Potential Energy Approach, derivation of stiffness matrix, Properties of stiffness matrix, Assembly of Global Stiffness Matrix and Load Vector, Boundary conditions elimination method and penalty method. Numerical Problems on straight, stepped bars. Analysis of Trusses and Beams with point load.

### UNIT III TWO DIMENSIONAL PROBLEMS 9 hours

Formulation of triangular and quadrilateral elements. Displacement models and shape functions for linear and higher order elements, Lagrangian and serendipity elements, Iso parametric – sub parametric – super parametric elements, Introduction to axisymmetric– triangular elements. Convergence criteria, pascal triangle. Numerical problems.

### UNIT IV DYNAMIC ANALYSIS 9 hours

Lagrange's equations, consistent and lumped mass matrices for bar and 2D truss Characteristic polynomial approach - Eigenvalues, Eigenvectors, natural frequencies, mode shapes for bars and 2D trusses.

### UNIT V APPLICATIONS IN HEAT TRANSFER AND FLUID MECHANICS 9 hours

Heat Transfer Problems: Steady state heat transfer, 1D heat conduction governing equation, boundary conditions, Numerical problems on slab, composite wall, 1D heat transfer in thin fins. Application to Fluid Mechanics.

**Course Outcomes:**

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

CO1: Explain the basic concepts, advantages, and numerical techniques of FEM, including elasticity theory and energy methods for mechanical systems. (L2)

CO2: Formulate and solve one-dimensional FEM problems involving bar, truss, and beam elements using stiffness matrix and boundary conditions. (L3)

CO3: Analyze 2D structural problems using various element types and shape functions including iso-parametric formulations and convergence criteria. (L4)

CO4: Compute dynamic response of mechanical systems by formulating mass matrices and solving eigenvalue problems to find natural frequencies and mode shapes. (L3)

CO5: Apply FEM to steady-state heat conduction and basic fluid flow problems and analyze temperature distribution in simple geometries. (L3)

**Text Books:**

1. Rao, S. S. (2021). The finite element method in engineering (6th ed.). Butterworth-Heinemann.
2. Logan, D. L. (2022). A first course in the finite element method (6th ed.). Cengage Learning.
3. Cook, R. D., Malkus, D. S., Plesha, M. E., & Witt, R. J. (2020). Concepts and applications of finite element analysis (5th ed.). Wiley.

**Reference Books:**

1. Hutton, D. V. (2017). Fundamentals of finite element analysis (2nd ed.). McGraw Hill Education.
2. Zienkiewicz, O. C., Taylor, R. L., & Zhu, J. Z. (2020). The finite element method: Its basis and fundamentals (8th ed.). Elsevier.
3. Bathe, K. J. (2021). Finite element procedures (2nd ed.). Prentice Hall.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Professional Elective – III**

## 23ME408 ELECTRIC AND HYBRID VEHICLE TECHNOLOGY

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** **None**

**Course Objectives:**

This course is designed to:

1. Introduce the fundamental concepts, historical evolution, and recent trends of electric vehicles (EVs) and compare them with internal combustion engine vehicles.
2. Impart knowledge on the types, specifications, and operational characteristics of traction motors used in EVs.
3. Provide insight into hybrid electric vehicle (HEV) configurations and their power flow control mechanisms.
4. Explain the characteristics, types, and infrastructure requirements of various battery charging methods used in EVs.
5. Familiarize students with Battery Management Systems (BMS), alternative energy sources, EV auxiliaries, and safety considerations.

**UNIT I INTRODUCTION TO ELECTRIC VEHICLE 9 hours**

A Brief History of EVs, Past, Present & Feature of EV, Current Major Issues, Recent Development Trends, EV Concept, Key EV Technology, State-of-the Art EVs & HEVs, Comparison of EV Vs IC Engine. EV Configuration: Fixed & variable gearing, single & multiple motor drive, In-wheel drives, EV Parameters: Weight, size, force, energy & performance parameters

**UNIT II INTRODUCTION TO TRACTION MOTORS 9 hours**

Propulsion Machine Overview - DC Machines, AC Machines, Induction motor, Switched reluctance motor, Permanent Magnetic BLDC Motor Drives: Comparison of Traction Machines, A case study; Machine Specification - Four-Quadrant Operation, Rated Parameters, Rated Torque, Rated and Base Speeds, Rated Power, Peak Operation, Starting Torque; Characteristic Curves of a Machine - Constant-Torque Mode, Constant-Power Mode, Maximum-Speed Mode, Efficiency Maps.

**UNIT III HYBRID ELECTRIC VEHICLE 9 hours**

Configuration of HEV (Series, Parallel, Series-parallel &Complex), Power Flow control, Examples. Power flow control in all HEV configurations, Examples of HEV system performance.

**UNIT IV BATTERY CHARGING 9 hours**

Battery characteristics (Discharging & Charging) Battery Chargers: Conductive (Basic charger circuits, Microprocessor based charger circuit. Arrangement of an off-board conductive charger, Standard power levels of conductive chargers, Inductive (Principle of inductive charging, Soft-switching power converter for inductive charging), Battery indication methods, Charging Infrastructure: Domestic Charging Infrastructure, Public Charging Infrastructure, Normal Charging Station, Occasional Charging Station, Fast Charging Station, Battery Swapping Station, Move-and charge zone.

**UNIT V BMS, ENERGY SOURCES, EV AUXILIARIES & SAFETY 9 hours**

Battery Management System (BMS), Fuel cells, Hybridization of energy sources, Temperature control units, Power steering units, Auxiliary power supplies, Navigation systems. Safety and Environment Aspects of EV Technology.

**Course Outcomes:**

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

CO1: Explain the development of electric vehicles over time, understand key enabling technologies, and perform a comparative analysis with conventional internal combustion engine vehicles. (L2)

CO2: Differentiate among various types of traction motors, examine their specifications, and analyze case studies to understand their application in EV propulsion. (L3)

CO3: Understand the different hybrid electric vehicle configurations and will interpret how power flows through these systems under various conditions. (L2)

CO4: Understand the working principles of battery charging methods, distinguish between conductive and inductive techniques, and assess the suitability of charging infrastructures. (L3)

CO5: Describe the functions of battery management systems, explore the integration of energy sources and auxiliaries, and assess the safety and environmental aspects of electric vehicle technology. (L3)

**Text Books:**

1. Husain, I. (2021). Electric and hybrid vehicles: Design fundamentals (3rd ed.). CRC Press.
2. Larminie, J., & Lowry, J. (2022). Electric vehicle technology explained (2nd ed.). Wiley.
3. Singh, M. (2023). Electric vehicles and future mobility (1st ed.). McGraw Hill Education.

**Reference Books:**

1. Ehsani, M., Gao, Y., & Longo, S. (2018). Modern electric, hybrid electric, and fuel cell vehicles: Fundamentals, theory, and design (3rd ed.). CRC Press.
2. Chau, K. T. (2015). Electric vehicle machines and drives: Design, analysis and application (1st ed.). Wiley.
3. Chan, C. C., & Chau, K. T. (2018). Electric and hybrid vehicles: Technologies, modeling and control (2nd ed.). Springer.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

# SKILL ENHANCEMENT COURSES

**Skill Enhancement Course - I**

## 23ENG601 SOFT SKILLS

| L | T | P | C |
|---|---|---|---|
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**Course Objectives:**

1. To encourage all round development of the students by focusing on soft skills
2. To make the students aware of critical thinking and problem-solving skills
3. To enhance healthy relationship and understanding within and outside an organization
4. To function effectively with heterogeneous teams

### UNIT I SOFT SKILLS & COMMUNICATION SKILLS 6 hours

Soft Skills - Introduction, Need - Mastering Techniques of Soft Skills – Communication Skills - Significance, process, types - Barriers of communication - Improving techniques.

**Activities:**

Intrapersonal Skills- Narration about self- strengths and weaknesses- clarity of thought – self- expression – articulating with felicity.

(The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes and literary sources)

Interpersonal Skills- Group Discussion – Debate – Team Tasks - Book and film Reviews by groups - Group leader presenting views (non- controversial and secular) on contemporary issues or on a given topic.

Verbal Communication- Oral Presentations- Extempore- brief addresses and speeches- convincing- negotiating- agreeing and disagreeing with professional grace.

Non-verbal communication – Public speaking – Mock interviews – presentations with an objective to identify non- verbal clues and remedy the lapses on observation

### UNIT II CRITICAL THINKING 6 hours

Active Listening – Observation – Curiosity – Introspection – Analytical Thinking – Open-mindedness – Creative Thinking - Positive thinking - Reflection

**Activities:**

Gathering information and statistics on a topic - sequencing – assorting – reasoning – critiquing issues –placing the problem – finding the root cause - seeking viable solution – judging with rationale – evaluating the views of others - Case Study, Story Analysis

### UNIT III PROBLEM SOLVING & DECISION MAKING 6 hours

Meaning & features of Problem Solving – Managing Conflict – Conflict resolution – Team building - Effective decision making in teams – Methods & Styles

**Activities:**

Placing a problem which involves conflict of interests, choice and views – formulating the problem – exploring solutions by proper reasoning – Discussion on important professional, career and organizational decisions and initiate debate on the appropriateness of the decision.

Case Study & Group Discussion

**UNIT IV EMOTIONAL INTELLIGENCE & STRESS MANAGEMENT 6 hours**

Managing Emotions – Thinking before Reacting – Empathy for Others – Self-awareness – Self-Regulation – Stress factors – Controlling Stress – Tips

**Activities:**

Providing situations for the participants to express emotions such as happiness, enthusiasm, gratitude, sympathy, and confidence, compassion in the form of written or oral presentations.
Providing opportunities for the participants to narrate certain crisis and stress –ridden situations caused by failure, anger, jealousy, resentment and frustration in the form of written and oral presentation,
Organizing Debates

**UNIT V Corporate Etiquette 6 hours**

Etiquette- Introduction, concept, significance - Corporate etiquette - meaning, modern etiquette, benefits - Global and local culture sensitivity - Gender Sensitivity - Etiquette in interaction- Cell phone etiquette - Dining etiquette - Netiquette - Job interview etiquette -Corporate grooming tips -Overcoming challenges

**Activities**

Providing situations to take part in the Role Plays where the students will learn about bad and good manners and etiquette - Group Activities to showcase gender sensitivity, dining etiquette etc. - Conducting mock job interviews - Case Study - Business Etiquette Games

**Note:**

1. The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes, epics, scriptures, autobiographies and literary sources which bear true relevance to the prescribed skill.
2. Case studies may be given wherever feasible for example for Decision Making- The decision of King Lear.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

CO1: List out various elements of soft skills (L1, L2)
CO2: Describe methods for building professional image (L1, L2)
CO3: Apply critical thinking skills in problem solving (L3)
CO4: Analyse the needs of an individual and team for well-being (L4)
CO5: Assess the situation and take necessary decisions (L5).
CO6: Create a productive workplace
atmosphere using social and work-life skills ensuring personal and emotional well-being (L6)

**Text Books:**

1. Mitra Barun K, Personality Development and Soft Skills, Oxford University Press, Pap/Cdr edition 2012.
2. Dr Shikha Kapoor, Personality Development and Soft Skills: Preparing for Tomorrow, I K International Publishing House, 2018.

**Reference Books:**


1. Sharma, Prashant, Soft Skills: Personality Development for Life Success, BPB Publications 2018
2. Alex K, Soft Skills S.Chand & Co, 2012 (Revised edition)
3. Gajendra Singh Chauhan & Sangeetha Sharma, Soft Skills: An Integrated Approach to Maximise Personality Published by Wiley, 2013
4. Pillai, Sabina & Fernandez Agna, Soft Skills and Employability Skills, Cambridge University Press, 2018.
5. Soft Skills for a Big Impact (English, Paperback, Renu Shorey) Publisher: Notion Press
6. Dr. Rajiv Kumar Jain, Dr. Usha Jain, Life Skills (Paperback English) Publisher : Vayu Education of India, 2014


**E Books:**

1. https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCytvXh0E_y-bOO1_q
2. https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KlJ
3. https://youtu.be/-Y-R9hDl7lU
4. https://youtu.be/gkLsn4ddmTs
5. https://youtu.be/2bf9K2rRWwo
6. https://youtu.be/FchfE3c2jzc
7. https://www.businesstrainingworks.com/training-resource/five-free-business-etiquette-training-games/
8. https://onlinecourses.nptel.ac.in/noc24_hs15/preview
9. https://onlinecourses.nptel.ac.in/noc21_hs76/preview

**Mode of Evaluation:** Continuous Internal Evaluation , Assignments, Mid Term Tests and End Semester Examination.

**Skill Enhancement Course - II**

## 23CSE601 PYTHON PROGRAMMING

| L | T | P | C |
|---|---|---|---|
| 1 | 0 | 2 | 2 |

**Course Objectives:**

The main objectives of the course are to

1. Introduce core programming concepts of Python programming language.
2. Learn to solve problems using Python conditional and loops.
3. Demonstrate about Python data structures like Lists, Tuples, Sets and dictionaries
4. Implement Functions, Modules and Regular Expressions in Python Programming and to create practical and contemporary applications.
5. Demonstrate to do input/output with files in Python.

### UNIT I DATA TYPES, EXPRESSIONS AND CONTROL FLOW STATEMENTS — 6 hours

**Introduction:** Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, the type () Function and Is Operator, Dynamic and Strongly Typed Language.

**Control Flow Statements:** if statement, if-else statement, if...elif…else, Nested if statement, while Loop, for Loop, continue and break Statements, Catching Exceptions Using try and except Statement.

Sample Experiments:

1. Write a program to find the largest element among three Numbers.
2. Write a program to swap two numbers without using a temporary variable.
3. Demonstrate the following Operators in Python with suitable examples.

i) Arithmetic Operators ii) Relational Operators iii) Assignment Operators iv) Logical Operators v) Bit wise Operators vi) Ternary Operator vii) Membership Operators viii) Identity Operators

### UNIT II LISTS & DICTIONARIES — 6 hours

**Lists:** Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, del Statement.

**Dictionaries:** Creating Dictionary, Accessing and Modifying key: value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, del Statement.

**Sample Experiments:**

4. Write a program to perform the given operations on a list:
   i. Addition ii. Insertion iii. slicing
5. Write a program to perform any 5 built-in functions by taking any list.
6. Write a program to sum all the items in a given dictionary.

### UNIT III TUPLES AND SETS — 6 hours

Tuples and Sets: Creating Tuples, Basic Tuple Operations, tuple() Function, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Using zip() Function, Sets, Set Methods, Frozenset.

Sample Experiments:

1. Write a program to create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenated tuples.
2. Write a program to count the number of vowels in a string (No control flow allowed).

3. Write a program to check if a given key exists in a dictionary or not.

**UNIT IV FUNCTIONS & STRINGS 6 hours**

**Functions:** Built-In Functions, Commonly Used Modules, Function Definition and Calling the function, return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.
**Strings:** Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

**Sample Experiments:**

1. Write a program to define a function with multiple return values.
2. Write a program to define a function using default arguments.
3. Write a program to find the length of the string without using any library functions.

**UNIT V FILES HANDLING IN PYTHON 6 hours**

**Files:** Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules.

**Sample Experiments:**

1. Write a program to sort words in a file and put them in another file. The output file should have only lower-case words, so any upper-case words from source must be lowered.
2. Implement a Python program to print each line of a file in reverse order.
3. Write a Python program to compute the number of characters, words and lines in a file

**Course Outcomes:**

After completion of the course, students will be able to

CO1: Understand to adept command of Python syntax, deftly utilizing variables, data types, and control structures.
CO2: Interpret Strings, functions, modules, exception handling to engineer robust and efficient code solutions.
CO3: Apply Python programming concepts like Lists and Dictionary to solve a variety of computational problems.
CO4: Build and manipulate fundamental data structures such as tuples and sets.
CO5: Demonstrate file handling concepts in python.

**Text Books:**

**1.** Gowri shankar S, Veena A., Introduction to Python Programming, CRC Press.

**2.** Python Programming, S Sridhar, J Indumathi, V M Hariharan, 2nd Edition, Pearson, 2024.

**Reference Books:**

**1.** Introduction to Programming Using Python, Y. Daniel Liang, Pearson.

**2.** Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.

**Online Resources:**

**1.** https://www.coursera.org/learn/python-for-applied-data-science-ai

**2.** https://www.coursera.org/learn/python?specialization=python#syllabus

**Mode of Evaluation**: Continuous Internal Evaluation , Assignments, Mid Term Tests and End Semester Examination.

**Skill Enhancement Course - III**

## 23ME601 MACHINE DYNAMICS AND MECHANICAL VIBRATIONS

| L | T | P | C |
|---|---|---|---|
| 1 | 0 | 2 | 2 |

**Pre-requisite:** **23ME108 THEORY OF MACHINES**

**Course Objectives:**

This course is designed to:

1. Understand the fundamental principles of machine dynamics involving cams, governors, gyroscopes, balancing, and vibrations.
2. Develop MATLAB-based simulations for analyzing dynamic systems and visualizing mechanical responses.
3. Apply analytical and numerical methods to solve problems in single and multi-degree of freedom systems.
4. Investigate the performance and stability of mechanisms through virtual labs and validate theoretical models.
5. Enhance programming, modeling, and visualization skills relevant to dynamic systems and mechanical vibrations using MATLAB.

### UNIT I CAMS 9 hours

An Introduction to MATLAB. Cams: Classification of cams and followers- Terminology and definitions- Displacement diagrams - Uniform velocity, parabolic, simple harmonic and cycloidal motions - cam profile.

**Experiments:**

1. Simulation of Follower Motion Diagrams
2. Cam Profile Generation and Animation
3. Determination of Jump Speed

### UNIT II GYROSCOPE 9 hours

Gyroscope: Principle of gyroscope, gyroscopic effect in an airplane, ship, car and two-wheeler.

**Experiments:**

4. Gyroscopic Couple Simulation
5. Gyroscopic Effect in Vehicles

### UNIT III GOVERNORS 9 hours

Governors: types and its applications. Watt governor, Proell governor, Porter governor, Hartnell governor.

**Experiments:**

6. Watt and Porter Governor Simulation
7. Hartnell and Proell Governor Analysis

### UNIT IV BALANCING 9 hours

Balancing of rotating masses, Single and multiple – single and different planes

**Experiments:**

8. Static and Dynamic Balancing of Rotating Masses

**UNIT V VIBRATIONS 9 hours**

Introduction, degree of freedom, types of vibrations, Damped vibrations, forced vibrations with and without damping in single degree of freedom.

**Experiments:**

9. Longitudinal Vibration of spring mass system
10. To verify the relation $t = 2 \pi \sqrt{l/g}$ for a simple pendulum
11. Whirling speed of shaft
12. Torsional Vibration of Rotor Systems

**Course Outcomes:**

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

CO1: Analyze the motion of cam-follower systems using MATLAB and interpret displacement, velocity, and acceleration. (L3)

CO2: Simulate the effect of gyroscopic couple on vehicles and evaluate its impact on stability. (L4)

CO3: Model and compare different types of governors and assess their effectiveness for speed control. (L4)

CO4: Perform static and dynamic balancing of rotating systems using MATLAB simulations. (L3)

CO5: Develop and solve mathematical models of mechanical vibrations using numerical techniques in MATLAB. (L5)

**Text Books:**

1. Lab manual provided by the department.
2. Rao, J. S. (2020). Theory of machines (4th ed.). New Age International.
3. Rattan, S. S. (2022). Theory of machines (5th ed.). McGraw Hill Education.
4. Singh, S. (2021). Theory of machines (3rd ed.). Pearson Education.

**Reference Books:**

1. Shigley, J. E., & Uicker, J. J. (2019). Theory of machines and mechanisms (5th ed.). Oxford University Press.
2. Ghosh, A., & Mallik, A. K. (2020). Theory of mechanisms and machines (3rd ed.). East-West Press.
3. Grover, G. K. (2021). Mechanical vibrations (8th ed.). Nem Chand & Bros.

**Virtual Labs:**

1. Machine Dynamics and Mechanical Vibrations Lab by NITK SURATHKAL: https://mdmv-nitk.vlabs.ac.in

**Mode of Evaluation:** Continuous Internal Evaluation , Assignments, Mid Term Tests and End Semester Examination.

**Skill Enhancement Course - IV**

## 23ME602 ROBOTICS AND 3D PRINTING

| L | T | P | C |
|---|---|---|---|
| 1 | 0 | 2 | 2 |

**Pre-requisite:** **None**

**Course Objectives:**

This course is designed to:

1. Introduce the fundamental concepts, types, and applications of robotics and the working principles of proximity sensors.
2. Familiarize students with commonly used robotic modules and actuator systems along with their control mechanisms.
3. Develop an understanding of control logic for autonomous robots and remote-controlled robotic systems.
4. Impart foundational knowledge of 3D printing technologies, including pre-processing steps such as modeling and slicing.
5. Explore various 3D printing materials and their real-world applications in different industries through hands-on projects.

### UNIT I INTRODUCTION TO ROBOTICS AND SENSORS 9 hours

Fundamentals of robotics: types, applications, and basic components. Overview of robotic sensors: working principles of Ultrasonic, Infrared, and other proximity sensors.

**Experiments:**

1. Experimental study on Ultrasonic and Infrared Sensors.
2. Calibration and integration of sensors with microcontrollers.

### UNIT II ROBOTIC MODULES AND ACTUATION SYSTEMS 9 hours

Introduction to common robotic modules: DHT (temperature/humidity), DTMF (remote control). Overview of actuators: DC motors, Servo motors, and Stepper motors – working principles and applications.

**Experiments:**

3. Experimental study on DHT and DTMF Modules.
4. Hands-on testing and control of DC, Servo, and Stepper motors.

### UNIT III ROBOT DEVELOPMENT AND CONTROL SYSTEMS 9 hours

Line following mechanism: concept of path detection and control logic. Mobile communication-based robotic control using DTMF signals.

**Experiments:**

5. Build and test a Line Following Robot using IR Sensors.
6. Develop a DTMF-controlled Robot for remote control using mobile phone.

### UNIT IV BASICS OF 3D PRINTING AND PRE-PROCESSING 9 hours

Introduction to Additive Manufacturing and 3D Printing. STL file generation, slicing process, and influence of parameters (layer thickness, orientation, infill).

**Experiments:**
7. Modelling an engineering component and exporting to STL.
8. Slicing the STL and analyzing effect of slicing parameters on print time using slicing software.

**UNIT V 3D PRINTING MATERIALS AND REAL-WORLD APPLICATIONS 9 hours**
Materials used in 3D printing: properties and comparison of ABS, PLA, etc. Applications of 3D printing in engineering, healthcare, and consumer products.

**Experiments:**
9. 3D printing components using ABS and PLA with varied parameters.
10. Accuracy analysis and printing of real-world functional components.

**Course Outcomes:**

At the end of the course, the student will be able to:
CO1: Identify and explain different types of robots and proximity sensors along with their working principles. (L2)
CO2: Compare and demonstrate the use of robotic modules (DHT, DTMF) and actuators (DC, Servo, Stepper) for basic motion control. (L3)
CO3: Construct and test a line-following robot and a DTMF-controlled robot based on given specifications. (L4)
CO4: Model, slice, and analyze engineering components for 3D printing by modifying key slicing parameters. (L4)
CO5: Differentiate between 3D printing materials and evaluate their suitability for various real-world applications. (L3)

**Text Books:**

1. Lab manual provided by the department.
2. Craig, J. J. (2022). *Introduction to robotics: Mechanics and control* (4th ed.). Pearson Education.
3. Gibson, I. (2021). *Additive manufacturing technologies: 3D printing, rapid prototyping, and direct digital manufacturing* (3rd ed.). Springer.
4. Magrab, E. B. (2020). *Sensors and control systems in manufacturing* (2nd ed.). CRC Press.

**Reference Books:**

1. Deb, S. R. (2021). *Robotics technology and flexible automation* (2nd ed.). McGraw Hill Education.
2. Bosché, F., & Ahmed, V. (2022). *3D printing: Applications in construction, healthcare, and manufacturing* (1st ed.). Routledge.
3. Wang, L., & Liang, S. Y. (Eds.). (2021). *Intelligent sensors and actuators in smart manufacturing* (1st ed.). Elsevier.

**Virtual Labs:**

1. 3D Printing Virtual Simulation Lab by Dayalbagh Educational Institute: https://3dp-dei.vlabs.ac.in

**Mode of Evaluation:** Continuous Internal Evaluation , Assignments, Mid Term Tests and End Semester Examination.

# Minor in Mechanical Engineering

## Stream Name: Thermal Engineering

### (Applicable to CE, EEE, ME, CSE, CST, CSE (AI), CSE (DS), CSE (CS), CSE (AI and ML) and CSE (Networks))

**Minor**

## 23MDME101 FLUID MECHANICS AND HYDRAULIC MACHINERY

| L | T | P | C |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

**Pre-requisite:** None

**Course Objectives:**

This course is designed to:

1. Impart knowledge on fundamental properties and behavior of fluids in static and dynamic conditions.
2. Equip students with analytical tools for solving pipe flow and fluid force problems.
3. Introduce concepts of flow measurement and dimensional analysis in engineering applications.
4. Explain the working principles, performance characteristics, and design aspects of hydraulic machines.
5. Develop competency in evaluating fluid machinery performance through theoretical and empirical approaches.

**UNIT I PROPERTIES OF FLUIDS AND FLUID STATICS 9 hours**

Definition and classification of fluids. Properties of fluids – density, viscosity, surface tension, compressibility. Concept of pressure, Pascal's law, hydrostatic law. Measurement of pressure using manometers. Forces on plane and curved surfaces, buoyancy, and metacentric height.

**UNIT II FLUID KINEMATICS AND DYNAMICS 9 hours**

Description of fluid motion – Lagrangian and Eulerian approaches. Streamlines, pathlines, streaklines. Continuity equation for incompressible flow. Euler's and Bernoulli's equations – assumptions and applications. Momentum equation and its use in force calculations on pipe bends and nozzles.

**UNIT III LAMINAR AND TURBULENT FLOW THROUGH PIPES 9 hours**

Reynolds number and flow regimes. Laminar flow through circular pipes – Hagen-Poiseuille equation. Transition to turbulence, characteristics of turbulent flow. Darcy-Weisbach equation, friction factor, Moody chart. Major and minor losses in pipes, pipes in series and parallel.

**UNIT IV DIMENSIONAL ANALYSIS AND FLOW MEASUREMENTS 9 hours**

Introduction to dimensional homogeneity and Buckingham $\pi$ theorem. Model analysis and similarity laws. Classification of models – distorted and undistorted. Flow measurement using venturimeter, orifice meter, nozzle, and rotameter. Calibration and use of flow devices.

**UNIT V HYDRAULIC MACHINERY – TURBINES AND PUMPS 9 hours**

Classification and working of turbines – Pelton, Francis, Kaplan. Velocity triangles and efficiency calculations. Draft tube and governing of turbines. Centrifugal and reciprocating pumps – working, characteristic curves, and performance analysis. Cavitation in pumps and turbines.

**Course Outcomes:**

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

CO1: Explain the properties of fluids and static pressure calculations on surfaces. (L2)
CO2: Apply fluid flow principles to solve kinematic and dynamic problems. (L3)
CO3: Analyze pipe flow systems, head losses, and flow regimes. (L4)
CO4: Interpret dimensional analysis results and compute discharge using flow measurement devices. (L4)
CO5: Evaluate the performance of turbines and pumps based on velocity triangles and efficiency expressions. (L4)

**Text Books:**

1. Cengel, Y.A. & Cimbala, J.M., Fluid Mechanics: Fundamentals and Applications, 5th Edition, McGraw Hill, 2023.
2. Bansal, R.K., A Textbook of Fluid Mechanics and Hydraulic Machines, 11th Edition, Laxmi Publications, 2022.
3. Subramanya, K., Fluid Mechanics and Hydraulic Machines, Revised Edition, McGraw Hill, 2023.

**Reference Books:**

1. White, F.M., Fluid Mechanics, 9th Edition, McGraw Hill, 2021.
2. Som, S.K., and Biswas, G., Introduction to Fluid Mechanics and Fluid Machines, 4th Edition, McGraw Hill, 2021.
3. Fox, R.W., McDonald, A.T., and Pritchard, P.J., Introduction to Fluid Mechanics, 9th Edition, Wiley, 2022.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Minor**

## 23MDME102 APPLIED THERMODYNAMICS

| L | T | P | C |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

**Pre-requisite:** None

**Course Objectives:**

This course is designed to:

1. Provide a deep understanding of thermodynamic principles as applied to real engineering systems.
2. Analyze and evaluate performance of various power and refrigeration systems.
3. Develop competency in gas mixtures, psychrometry, and combustion analysis.
4. Enable critical application of second law concepts for system efficiency and irreversibility assessment.
5. Foster problem-solving skills for real-world applications involving energy systems and thermal equipment.

### UNIT I THERMODYNAMIC FUNDAMENTALS AND SECOND LAW APPLICATIONS 9 hours

Review of thermodynamic systems, properties, and processes. Application of first and second laws to closed and open systems. Concept of entropy, Clausius inequality, entropy generation, and irreversibility. Availability and exergy, second law efficiency for components and systems.

### UNIT II GAS POWER CYCLES AND INTERNAL COMBUSTION ENGINES 9 hours

Overview of air-standard cycles – Otto, Diesel, Dual, Brayton, and Atkinson. Derivation of efficiency equations and comparison. Real cycle deviations. Working of SI and CI engines. Analysis of P-v and T-s diagrams. Combustion stages, performance parameters, and effect of operating variables.

### UNIT III VAPOUR POWER AND REFRIGERATION SYSTEMS 9 hours

Analysis of Rankine cycle and modifications – reheat, regeneration, and superheating. Binary vapour cycle and efficiency improvement methods. Working of vapor compression refrigeration and absorption refrigeration systems. Use of refrigerants, COP evaluation, and component analysis.

### UNIT IV GAS MIXTURES AND PSYCHROMETRIC APPLICATIONS 9 hours

Definition and properties of ideal gas mixtures. Use of Dalton's and Amagat's laws. Determination of mixture properties. Psychrometric terms and relations. Use of psychrometric chart for air-conditioning calculations. Cooling and dehumidification, heating and humidification processes.

### UNIT V COMBUSTION AND REAL-TIME APPLICATIONS 9 hours

Introduction to combustion reactions, chemical equations, and fuel classification. Calculation of stoichiometric air-fuel ratio, excess air, and products of combustion. Enthalpy of formation and adiabatic flame temperature. Application to boilers, gas turbines, and industrial thermal systems.

**Course Outcomes:**

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

CO1: Explain thermodynamic cycles and their relevance to modern thermal systems. (L2)
CO2: Apply the principles of air-standard cycles, vapor cycles, and real gas behavior. (L3)
CO3: Analyze psychrometric processes and gas-vapor mixtures for HVAC applications. (L4)
CO4: Evaluate combustion processes using chemical equations and energy balance. (L4)
CO5: Solve complex engineering problems related to IC engines, turbines, compressors, and refrigeration systems. (L4)

**Text Books:**

1. Nag, P.K., Engineering Thermodynamics, 7th Edition, McGraw Hill Education, 2021.
2. Cengel, Y.A., and Boles, M.A., Thermodynamics: An Engineering Approach, 9th Edition, McGraw Hill, 2023.
3. Van Wylen, G.J., Sonntag, R.E., and Borgnakke, C., Fundamentals of Classical Thermodynamics, 9th Edition, Wiley, 2022.

**Reference Books:**

1. Arora, C.P., Thermodynamics and Heat Engines, Revised Edition, Vikas Publishing, 2022.
2. Jones, J.B. and Dugan, R.E., Engineering Thermodynamics, Pearson Education, 2023.
3. Dossat, R.J. and Horan, T.J., Principles of Refrigeration, 6th Edition, Pearson, 2021.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Minor**

**23MDME201 FLUID MECHANICS AND HYDRAULIC MACHINERY LABORATORY**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Pre-requisite: None**

**Course Objectives:**

This course is designed to:

1. Provide hands-on experience in validating fundamental fluid mechanics principles.
2. Enable students to measure flow parameters using standard flow measuring devices.
3. Familiarize students with evaluation of hydraulic losses in pipe systems.
4. Develop experimental skills for testing and analyzing performance of turbines and pumps.
5. Enhance data interpretation and report writing abilities through laboratory investigations.

**List of Experiments:**

1. Verification of Bernoulli's theorem
2. Determination of Coefficient of discharge of Venturimeter
3. Determination of Coefficient of discharge of Orificemeter
4. Determination of Coefficient of discharge of Turbine flow meter.
5. Determination of friction factor for a given pipeline.
6. Determination of loss of head due to sudden enlargement and contraction in a pipeline.
7. Performance test on Pelton wheel.
8. Performance test on Francis turbine.
9. Performance test on Kaplan turbine.
10. Performance test on centrifugal pump.
11. Performance test on reciprocating pump.

**Course Outcomes:**

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

CO1: Demonstrate Bernoulli's principle and validate it using flow experiments. (L3)

CO2: Determine coefficient of discharge for various flow meters including venturimeter, orificemeter, and turbine flow meter. (L3)

CO3: Evaluate friction factor and head losses due to sudden changes in pipe geometry. (L4)

CO4: Conduct performance tests on Pelton, Francis, and Kaplan turbines and analyze efficiency. (L4)

CO5: Test the operational characteristics of centrifugal and reciprocating pumps and compare with theoretical values. (L4)

**Reference Books:**

1. Lab manual provided by the department.

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination

**Minor**

## 23MDME103 HEAT TRANSFER

| L | T | P | C |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

**Pre-requisite:** **None**

**Course Objectives:**

This course is designed to:

1. Introduce fundamental concepts and governing laws of heat transfer.
2. Develop analytical and empirical techniques for conduction, convection, and radiation problems.
3. Enable thermal analysis of transient and multidimensional systems.
4. Apply knowledge to practical devices such as heat exchangers and cooling systems.
5. Foster problem-solving skills through numerical and experimental heat transfer evaluations.

**UNIT I CONDUCTION HEAT TRANSFER 9 hours**

Introduction to modes of heat transfer. Fourier's law and general heat conduction equation. One-dimensional steady-state heat conduction in plane wall, cylinder, and sphere. Composite systems and thermal resistance concept. Critical radius of insulation. Variable thermal conductivity and heat generation.

**UNIT II UNSTEADY AND MULTIDIMENSIONAL CONDUCTION 9 hours**

Transient heat conduction in solids using lumped capacitance method and Heisler charts. Analytical and numerical methods for unsteady heat conduction. Multidimensional conduction using graphical and finite difference methods. Applications in thermal systems and electronic cooling.

**UNIT III CONVECTIVE HEAT TRANSFER 9 hours**

Introduction to convection and Newton's law of cooling. Concepts of boundary layer and dimensional analysis in forced convection. Empirical correlations for internal and external flows. Free convection on vertical and horizontal surfaces. Heat transfer in boiling and condensation.

**UNIT IV RADIATIVE HEAT TRANSFER 9 hours**

Basic laws of radiation – black body, emissivity, absorptivity, reflectivity. Stefan-Boltzmann law, Kirchhoff's law, and Planck's law. Radiation heat exchange between black and gray surfaces. Shape factors and radiation shields. Network analysis for radiation exchange in enclosures.

**UNIT V HEAT EXCHANGERS AND APPLICATIONS 9 hours**

Classification of heat exchangers. Analysis using LMTD and effectiveness–NTU methods. Fouling factor and overall heat transfer coefficient. Performance evaluation and design considerations. Special topics – compact heat exchangers, finned tubes, and regenerative systems.

**Course Outcomes:**

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

CO1: Explain fundamental heat transfer mechanisms and calculate steady-state conduction in basic geometries. (L3)

CO2: Solve unsteady conduction problems using analytical and approximate methods. (L3)

CO3: Apply empirical correlations and boundary layer concepts to convection heat transfer problems. (L3)

CO4: Analyze radiation heat exchange between real and idealized surfaces. (L4)

CO5: Evaluate and design heat exchangers using effectiveness and LMTD approaches. (L4)

**Text Books:**

1. Cengel, Y.A. & Ghajar, A.J., Heat and Mass Transfer: Fundamentals and Applications, 6th Edition, McGraw Hill, 2023.
2. Incropera, F.P., DeWitt, D.P., Bergman, T.L., & Lavine, A.S., Fundamentals of Heat and Mass Transfer, 8th Edition, Wiley, 2023.
3. Nag, P.K., Heat and Mass Transfer, 4th Edition, McGraw Hill, 2022.

**Reference Books:**

1. Holman, J.P., Heat Transfer, 11th Edition, McGraw Hill, 2021.
2. Arora, S.C. & Domkundwar, S., A Course in Heat and Mass Transfer, Revised Edition, Dhanpat Rai, 2021.
3. Yunus A. Çengel, Afshin J. Ghajar, Essentials of Heat and Mass Transfer, SI Edition, McGraw Hill, 2023.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Minor**

## 23MDME104 COMPUTATIONAL FLUID DYNAMICS

| L | T | P | C |
|---|---|---|---|
| 2 | 1 | 0 | 3 |

**Pre-requisite:** **None**

**Course Objectives:**

This course is designed to:

1. Introduce the fundamentals of CFD and mathematical modeling of fluid flow.
2. Develop understanding of discretization techniques and numerical methods.
3. Enable students to solve fluid flow and heat transfer problems using computational tools.
4. Familiarize with turbulence modeling and commercial CFD software.
5. Train students in interpreting and validating simulation results in engineering applications.

**UNIT I INTRODUCTION AND GOVERNING EQUATIONS 9 hours**

Overview of CFD and its applications. Conservation laws – mass, momentum, and energy equations. Derivation of Navier-Stokes equations. Classification of PDEs – elliptic, parabolic, and hyperbolic. General boundary and initial conditions for fluid flow problems.

**UNIT II DISCRETIZATION METHODS AND MESH GENERATION 9 hours**

Finite difference method – forward, backward, and central differencing. Truncation error and stability. Grid generation techniques – structured, unstructured, and body-fitted grids. Concept of discretization and control volumes. Finite volume method and its integral approach.

**UNIT III SOLUTION OF FLOW PROBLEMS 9 hours**

Solution of 1D steady and unsteady heat conduction. Convection-diffusion equation – numerical treatment. Algorithm for pressure-velocity coupling – SIMPLE and SIMPLEC. Solution of incompressible viscous flow using stream function-vorticity and primitive variable formulations.

**UNIT IV TURBULENCE MODELING 9 hours**

Need for turbulence modeling. Reynolds Averaged Navier-Stokes (RANS) equations. Turbulence models – zero-equation, one-equation (Spalart-Allmaras), and two-equation models (k-ε, k-ω). Near-wall treatment, wall functions, and model comparison for industrial applications.

**UNIT V CFD APPLICATIONS AND SOFTWARE 9 hours**

Overview of CFD software – ANSYS Fluent, OpenFOAM, COMSOL Multiphysics. Pre-processing, solver settings, and post-processing. Mesh independence and validation. Case studies – flow over airfoils, pipe flows, heat exchangers, and mixing problems in process industries.

**Course Outcomes:**

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

CO1: Formulate governing equations for fluid flow and classify partial differential equations. (L2)
CO2: Apply discretization techniques to derive finite difference and finite volume equations. (L3)
CO3: Solve basic convection-diffusion and viscous flow problems numerically. (L4)
CO4: Analyze turbulence using appropriate RANS-based models and interpret near-wall phenomena. (L4)
CO5: Simulate engineering flow problems using commercial CFD software and validate results. (L4)

**Text Books:**

1. Versteeg, H.K. & Malalasekera, W., An Introduction to Computational Fluid Dynamics: The Finite Volume Method, 3rd Edition, Pearson Education, 2023.
2. Muralidhar, K. & Sundararajan, T., Computational Fluid Flow and Heat Transfer, 4th Edition, Narosa Publishing, 2022.
3. Ferziger, J.H., Perić, M., & Street, R.L., Computational Methods for Fluid Dynamics, 4th Edition, Springer, 2023.

**Reference Books:**

1. Blazek, J., Computational Fluid Dynamics: Principles and Applications, 4th Edition, Butterworth-Heinemann, 2023.
2. Anderson, J.D., Computational Fluid Dynamics: The Basics with Applications, McGraw Hill, Reprint 2022.
3. Tu, J., Yeoh, G.H., & Liu, C., Computational Fluid Dynamics: A Practical Approach, 4th Edition, Elsevier, 2023.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Minor**

## 23MDME202 THERMAL ENGINEERING LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Pre-requisite: None**

**Course Objectives:**

This course is designed to:

1. To provide hands-on experience in dismantling and assembling internal combustion (IC) engines to understand their construction and function.
2. To facilitate the analysis of port and valve timing for both two-stroke and four-stroke engines.
3. To assess engine performance parameters such as power, efficiency, friction, and heat balance under various operating conditions.
4. To enable students to perform and interpret emission testing, air compression, and psychrometric measurements.
5. To offer exposure to auxiliary systems such as vapour compression refrigeration rigs and boilers used in thermal engineering applications.

**List of Experiments:**

1. Dismantling and assembly of engines to identify the parts and their positions.
2. Port and valve timing diagrams of an 2-stroke and 4-stroke I.C. engines.
3. Performance test on a 4 -stroke diesel engine.
4. Performance test on 2-stroke petrol engine.
5. Evaluation of engine friction by conducting morse test on 4-stroke multi cylinder engine.
6. Heat balance test on an I.C. Engine.
7. Study on performance characteristics of a variable compression ratio engine.
8. Exhaust emission test on I.C. engines.
9. Performance test on reciprocating air compressor unit.
10. Determination of WBT, DBT, RH of moist air.
11. Study on vapour compression test rig.
12. Study of boilers.

**Course Outcomes:**

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

CO1: Identify engine components and demonstrate the correct procedure for dismantling and reassembling IC engines. (L2)

CO2: Construct valve and port timing diagrams and analyze their implications on engine performance. (L3)

CO3: Conduct performance and heat balance tests on various IC engines and interpret the results to evaluate efficiency. (L4)

CO4: Measure engine friction using Morse test and examine its effect on engine output. (L4)

CO5: Evaluate psychrometric properties of air and compare the performance of thermal systems like compressors, refrigeration rigs, and boilers. (L3)

**Reference Books:**

1. Lab manual provided by the department.

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination

# Minor in Quantum Computing

## (Applicable to CE, EEE, ME, ECE, CSE, CST, CSE (AI), CSE (DS), CSE (CS), CSE (AI and ML) and CSE (Networks))

**Minors**

## 23MDINS101 INTRODUCTION TO QUANTUM COMPUTING

| | L | T | P | C |
|---|---|---|---|---|
| **Pre-requisite:** None | 3 | 0 | 0 | 3 |

**Course Description:**

This course introduces the basics of quantum mechanics as applied to computing. Students learn about qubits, quantum gates, circuits, and key algorithms like Grover's and Shor's. Concepts such as superposition, entanglement, and quantum communication are explored. Practical exposure is given through programming on platforms like IBM Qiskit.

**Course Objectives:**

1. Understand quantum mechanics principles in computing.
2. Explore qubits, quantum gates, and circuits.
3. Analyze the advantages of quantum algorithms.
4. Study entanglement, superposition, and interference.
5. Investigate real-world applications and platforms.

**UNIT I QUBITS AND QUANTUM FOUNDATIONS 9 hours**

Classical Bits vs Qubits, Postulates of Quantum Mechanics, Superposition and Probability Amplitudes, Dirac Notation (Bra-Ket), Bloch Sphere Representation, Measurement in Quantum Systems, Quantum State Collapse.

**UNIT II QUANTUM GATES AND CIRCUITS 9 hours**

Quantum Logic Gates: Pauli-X, Y, Z; Hadamard (H); Phase (S, T), Controlled Gates: CNOT, Toffoli, Unitary and Reversible Operations, Quantum Circuit Representation, Building Basic Quantum Circuits, Quantum Parallelism and Interference, No-Cloning Theorem and Quantum Gate Simulation.

**UNIT III QUANTUM ALGORITHMS 9 hours**

Need for Quantum Algorithms, Deutsch and Deutsch-Jozsa Algorithm, Grover's Search Algorithm (Quadratic Speed-up), Shor's Factoring Algorithm (Exponential Speed-up), Simon's Algorithm (Overview), Complexity Comparison: Classical vs Quantum.

**UNIT IV ENTANGLEMENT AND QUANTUM COMMUNICATION 9 hours**

Quantum Entanglement and Bell States, Quantum Teleportation Protocol, Superdense Coding, Quantum Key Distribution: BB84, E91 Protocols, Decoherence and Quantum Noise, Quantum Error Correction Codes (Bit Flip, Phase Flip, Shor Code).

**UNIT V QUANTUM PLATFORMS AND APPLICATIONS 9 hours**

Overview of Quantum Programming Platforms: IBM Qiskit, Microsoft Q#, Google Cirq, Quantum Circuit Simulation using Qiskit, Executing Code on Real Quantum Hardware (IBM Q). Quantum Applications in:Cryptography, Machine Learning, Optimization, Chemistry, Building and Testing a Sample Quantum Program.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

**CO1:** Explain concepts of quantum mechanics
**CO2:** Illustrate quantum gates/circuits
**CO3:** Analyze algorithms (e.g., Shor, Grover)
**CO4:** Evaluate communication protocols
**CO5:** Develop quantum programs on IBM Q

## Text Books:

1. **Michael A. Nielsen & Isaac L. Chuang** – *Quantum Computation and Quantum Information*, Cambridge University Press, 10th Anniversary Edition.
2. **David McMahon** – *Quantum Computing Explained*, Wiley.
3. **Bernhardt, Chris** – *Quantum Computing for Everyone*, MIT Press.

## Reference Books:

1. **Mermin, N. David** – *Quantum Computer Science: An Introduction*, Cambridge University Press.
2. **William H. Press et al.** – *Numerical Recipes in C: The Art of Scientific Computing* (for simulation background)
3. **Rieffel&Polak** – *Quantum Computing: A Gentle Introduction*, MIT Press.
4. **Mermin, N. David** – *Quantum Computer Science: An Introduction*, Cambridge University Press.
5. **William H. Press et al.** – *Numerical Recipes in C: The Art of Scientific Computing* (for simulation background)
6. **Rieffel&Polak** – *Quantum Computing: A Gentle Introduction*, MIT Press.

**Online Courses & Resources:**
**IBM Qiskit:** IBM Qiskit Textbook:Hands-on, beginner-friendly curriculum for quantum programming
**Coursera:***Quantum Mechanics for Scientists and Engineers* by Stanford (Leonard Susskind)

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Minors**

## 23MDINS102 MATHEMATICAL FOUNDATIONS FOR QUANTUM COMPUTING

| | L | T | P | C |
|---|---|---|---|---|
| **Pre-requisite:** None | **3** | **0** | **0** | **3** |

**Course Description:**

This course covers the mathematical tools required for quantum computing. It focuses on linear algebra, complex vector spaces, eigenvalues, and probability theory in quantum systems. Students gain skills to model quantum states and analyze measurements. These foundations prepare them for understanding quantum algorithms.

**Course Objectives:**

1. Cover linear algebra & complex vector spaces.
2. Model quantum states mathematically.
3. Apply probability theory to measurements.
4. Study eigenvalues and transformations.
5. Prepare for algorithm analysis with rigor.

**UNIT I FOUNDATIONS OF COMPLEX VECTOR SPACES 9 hours**

Complex Numbers: Polar form, Euler's formula, Vectors in $\mathbb{C}^n$, Inner Product Spaces, Dirac Notation (Bra-Ket), Hilbert Space: Definitions and Properties, Orthogonality and Completeness, Norms, Metrics, and Distance in Complex Spaces.

**UNIT II MATRIX ALGEBRA AND OPERATORS 9 hours**

Matrix Multiplication and Linear Transformations, Special Matrices: Identity, Diagonal, Unitary, Tensor Products of Matrices and Vectors, Kronecker Product Applications, Unitary and Invertible Operators, Quantum Gates as Linear Operators.

**UNIT III EIGEN CONCEPTS AND QUANTUM OBSERVABLES 9 hours**

Eigenvalues and Eigenvectors, Hermitian Operators and Spectral Theorem, Quantum Observables and Expectation Values, Commutators and Compatibility, Measurement Operators and Matrix Diagonalization, Applications in Quantum Gate Analysis.

**UNIT IV QUANTUM MEASUREMENT & PROBABILITY 9 hours**

Basics of Probability Theory in Quantum Systems, Born's Rule and Measurement Probabilities, Projection Postulate, Density Matrix Formalism, Mixed States and Pure States, Trace, Partial Trace, and Operator Sums.

**UNIT V ADVANCED STRUCTURES IN QUANTUM MATH 9 hours**

Group Theory Basics: Symmetry, Permutations, Pauli Group, Clifford Group, and their roles, Fourier Transform in Quantum Context, Gram-Schmidt Orthogonalization, Lie Groups and Lie Algebras, Use of Lie Algebra in Hamiltonian Formulation.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

**CO1:** Explain concepts of quantum mechanics
**CO2:** Illustrate quantum gates/circuits
**CO3:** Analyze algorithms (e.g., Shor, Grover)
**CO4:** Evaluate communication protocols
**CO5:** Develop quantum programs on IBM Q

## Text Books:

1. **Nielsen & Chuang** – *Quantum Computation and Quantum Information*, Cambridge University Press
2. **Brian C. Hall** – *Quantum Theory for Mathematicians*, Springer
3. **T.S. Blyth & E.F. Robertson** – *Basic Linear Algebra*, Springer

## Reference Books:

1. **Roman S.** – *Advanced Linear Algebra*, Springer
2. **Axler, Sheldon** – *Linear Algebra Done Right*, Springer
3. **Shankar, R.** – *Principles of Quantum Mechanics*, Springer
4. **W. Greiner** – *Quantum Mechanics: An Introduction*, Springer

**Online Courses & Resources:**
**MIT OpenCourseWare:***Linear Algebra (Gilbert Strang):*Link
**edX:***Mathematics for Quantum Computing* by TUDelft:Link
**Khan Academy:***Linear Algebra, Probability & Statistics:*Link
**Quantum Country:***Spaced Repetition & Essays on Quantum Math:*Link

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Minors**

## 23MDINS201 QUANTUM PROGRAMMING AND SIMULATION LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Prerequisties:** None

**Course Description:**

This lab provides hands-on experience with quantum algorithms. Students implement and simulate algorithms such as Deutsch-Jozsa, Grover's search, Shor's algorithm, and teleportation. Both simulation and real hardware platforms are used. The focus is on practical understanding and experimentation.

**Course Objectives:**

1. To train students in programming quantum circuits using Qiskit, Q#, and related tools.
2. To explore advanced quantum simulations for teleportation, QFT, and hybrid models.
3. To develop practical skills in debugging and optimizing quantum programs.
4. To expose learners to both simulated environments and real quantum devices.
5. To motivate students through project-based learning in quantum applications.

**List of Experiments:**

1. State Vector Simulation (Qiskit)
2. Bell State Implementation
3. Deutsch-Jozsa Circuit
4. Grover's Search in Qiskit
5. QFT Circuit in Python
6. Shor Algorithm Simulation
7. Quantum Teleportation in Code
8. VQE (Hybrid Circuit)
9. QAOA Simulation
10. Quantum Random Number Generator
11. Comparison: Real vs Simulated Runs
12. Mini-Project: Quantum Password Cracker

**Course Outcomes:**

**CO1:** Ability to program and simulate quantum algorithms effectively.
**CO2:** Proficiency in using platforms like IBM Qiskit and Microsoft Q# for experimentation.
**CO3:** Understanding of differences between simulated and real hardware execution.
**CO4:** Skills to implement hybrid quantum-classical solutions such as VQE and QAOA.
**CO5:** Experience in developing a mini-project showcasing applied quantum computing.

**Reference Books:**

1. Michael Nielsen & Isaac Chuang – *Quantum Computation and Quantum Information*
2. Eric R. Johnston et al. – *Programming Quantum Computers*
3. David McMahon – *Quantum Computing Explained*
4. Gilbert Strang – *Introduction to Linear Algebra*
5. Sarah Kaiser & Chris Granade – *Learn Quantum Computing with Python and Q#*

**Online Learning Resources/Virtual Labs:**

IBM Qiskit Textbook: https://qiskit.org/learn
Microsoft Q# Documentation: https://learn.microsoft.com/en-us/azure/quantum/
Coursera: *Introduction to Quantum Computing*
edX: *Quantum Computing Fundamentals, Quantum Algorithms*

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination.

**Minors**

## 23MDINS103 QUANTUM ALGORITHMS

| | L | T | P | C |
|---|---|---|---|---|
| **Pre-requisite:** None | **3** | **0** | **0** | **3** |

**Course Description:**

This course explores the design and analysis of algorithms in the quantum domain. Students study key algorithms like Deutsch, Grover's search, and Shor's factoring, along with Fourier-based methods. The course highlights the speed-up of quantum methods over classical ones. Implementation on real frameworks like Qiskit is emphasized.

**Course Objectives:**

1. Understand algorithm design principles in the quantum domain.
2. Use mathematical tools such as linear algebra and probability in algorithm analysis.
3. Implement quantum algorithms and compare them with classical equivalents.
4. Study key applications in cryptography, database search, and optimization.

**UNIT I MATHEMATICAL TOOLS FOR QUANTUM ALGORITHMS 9 hours**

Review of Complex Numbers & Linear Algebra for Quantum Computing, Inner Product Spaces, Hilbert Spaces, Dirac Notation and Interpretations, Quantum State Vectors and Superposition, Overview of Quantum Gates and Operators, Building Block Concepts for Algorithmic Design.

**UNIT II SEARCH AND ORACLE-BASED ALGORITHMS 9 hours**

**Deutsch's Algorithm**: Problem and Solution Strategy, **Simon's Algorithm**: Period-finding and Speed-up Over Classical, **Grover's Search Algorithm**: Amplitude Amplification, Oracle Construction in Grover's Algorithm, Circuit Analysis and Complexity Comparison, Limitations and Applications in Database Search.

**UNIT III EIGEN CONCEPTS AND QUANTUM OBSERVABLES 9 hours**

Eigenvalues and Eigenvectors, Hermitian Operators and Spectral Theorem, Quantum Observables and Expectation Values, Commutators and Compatibility, Measurement Operators and Matrix Diagonalization, Applications in Quantum Gate Analysis.

**UNIT IV FOURIER-BASED & CRYPTOGRAPHIC ALGORITHMS 9 hours**

**Quantum Fourier Transform (QFT)**: Theory and Circuit, **Phase Estimation Algorithm**: Foundations and Usage, **Shor's Algorithm**: Integer Factorization and Discrete Logarithms, Modular Arithmetic and Period Finding, Cryptographic Implications of Quantum Algorithms, Efficiency Analysis vs Classical RSA Factorization.

**UNIT V ADVANCED & HYBRID QUANTUM ALGORITHMS 9 hours**

**Variational Quantum Eigensolver (VQE), Quantum Approximate Optimization Algorithm (QAOA), Quantum Machine Learning (QML)**: Classification & Clustering, Hybrid Quantum-Classical Models, IBM Qiskit&Cirq for Implementation, Building Custom Quantum Algorithms for NISQ Devices.

**Course Outcomes:**

**CO1:** Understand quantum algorithm building blocks

**CO2:** Analyze well-known quantum algorithms

**CO3:** Apply quantum algorithms to application domains

**CO4:** Evaluate efficiency and complexity of algorithms

**CO5:** Create and simulate quantum algorithms

## Text Books:

1. **Michael A. Nielsen & Isaac L. Chuang** – *Quantum Computation and Quantum Information*, Cambridge University Press
2. **Cristopher Moore & Stephan Mertens** – *The Nature of Computation*, Oxford University Press
3. **Eleanor G. Rieffel& Wolfgang Polak** – *Quantum Computing: A Gentle Introduction*, MIT Press

## Reference Books:

1. **Gideon Amir** – *Quantum Algorithms via Linear Algebra*, MIT Press
2. **S. Jordan** – *Quantum Algorithm Zoo*, [Online repository]
3. **T. G. Wong** – *Quantum Algorithm Design Techniques*
4. **Roland, Cerf** – *Quantum Search Algorithms*, Springer

**Online Courses & Resources:**

| | | |
|---|---|---|
| **edX (MIT)** | *Quantum Algorithms for Cybersecurity* | Link |
| **Coursera** | *Quantum Computing* by University of London | Link |
| **Qiskit Textbook** | *Algorithms & Quantum Machine Learning Modules* | Link |
| **Braket (AWS)** | *Quantum Computing Developer Tools & Tutorials* | Link |

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Minors**

## 23MDINS104 QUANTUM INFORMATION AND COMMUNICATION

| | L | T | P | C |
|---|---|---|---|---|
| **Pre-requisite:** | **3** | **0** | **0** | **3** |

**Course Description:**

This course introduces quantum information theory and its role in communication. Topics include entropy, fidelity, quantum teleportation, and quantum key distribution. Students analyze security protocols and the challenges of building quantum networks. Practical tools like Qiskit and NetSquid are used for simulation.

**Course Objectives:**

1. Understand the principles of quantum information theory.
2. Explore quantum entropy, fidelity, and mutual information.
3. Study quantum communication protocols and networks.
4. Analyze quantum key distribution and cryptographic security.
5. Implement protocols like teleportation and superdense coding.

**UNIT I QUANTUM INFORMATION BASICS 9 hours**

Classical vs Quantum Information, Density matrices and mixed states, Quantum entropy and Shannon entropy, Von Neumann entropy, Quantum data compression.

**UNIT II QUANTUM COMMUNICATION PROTOCOLS 9 hours**

Quantum teleportation, Superdense coding, Quantum repeaters and communication channels, No-cloning theorem, Quantum channel capacity.

**UNIT III FIDELITY, DISTANCE & INFORMATION THEORY 9 hours**

Fidelity and trace distance, Quantum mutual information, Holevo bound, Information trade-offs in communication, Channel noise and error modeling.

**UNIT IV QUANTUM CRYPTOGRAPHY 9 hours**

Principles of quantum cryptography, BB84 and B92 key distribution protocols, Eavesdropping and security analysis, Quantum bit commitment, Post-quantum cryptography relevance.

**UNIT V APPLICATIONS & TOOLS 9 hours**

Quantum internet: architecture and challenges, Networked quantum systems, Simulation using Qiskit, NetSquid, QuTiP, IBM Q Network and cloud-based setups, Practical implementation of QKD in simulation.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

**CO1:** Understand quantum information concepts

**CO2:** Apply quantum communication protocols

**CO3:** Analyze fidelity, entropy, and data transfer limits

**CO4:** Evaluate quantum cryptographic techniques

**CO5:** Create and simulate quantum communication models

## Text Books:

1. **Michael A. Nielsen & Isaac L. Chuang** – *Quantum Computation and Quantum Information*, Cambridge University Press
2. Mark M. Wilde – *Quantum Information Theory*, Cambridge University Press
3. John Watrous – *The Theory of Quantum Information*, Cambridge University Press

## Reference Books:

1. Peter W. Shor – *Foundations of Quantum Computing* (Lecture notes)
2. Charles H. Bennett & Gilles Brassard – *Original Papers on QKD (BB84)*
3. Stephanie Wehner – *Quantum Communication Networks*, arXiv

**Online Courses & Resources:**

| | | |
|---|---|---|
| **Coursera** | *Quantum Cryptography* by University of Geneva | Coursera Link |
| **edX** | *Quantum Information Science I* (Harvard/MIT) | edX Course |
| **Qiskit** | *Quantum Information Applications in Qiskit Textbook* | Qiskit Info |
| **QuTech** | *Quantum Internet Tutorials & Tools* | QuTech |

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Minors**

## 23MDINS202 QUANTUM ALGORITHMS LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Prerequisties**: None

**Course Descriptions:** This lab provides hands-on experience with quantum algorithms. Students implement and simulate algorithms such as Deutsch-Jozsa, Grover's search, Shor's algorithm, and teleportation. Both simulation and real hardware platforms are used. The focus is on practical understanding and experimentation.

**Course Objectives:**

1. To provide hands-on practice in implementing quantum algorithms.
2. To understand the working of algorithms like Grover's, Shor's, and Deutsch-Jozsa.
3. To strengthen the link between theoretical knowledge and practical applications.
4. To familiarize students with quantum simulators and real hardware platforms.
5. To encourage problem-solving through quantum circuit design.

**List of Experiments**

1. Deutsch Algorithm
2. Deutsch-Jozsa
3. Grover's Algorithm
4. QFT Visualization
5. Shor's Algorithm
6. QRNG Implementation
7. Bell State Entanglement
8. Bernstein-Vazirani Algorithm
9. Quantum Teleportation
10. Phase Estimation
11. Circuit Simulation
12. Mini-Project: RSA Key Breaking

**Course Outcomes:**

**CO1:** Ability to design and implement basic quantum algorithms.
**CO2:** Skill to simulate and test quantum circuits using software tools.
**CO3:** Competence in analyzing the performance of algorithms on quantum platforms.
**CO4:** Capability to compare classical vs quantum approaches for given problems.
**CO5:** Practical experience in applying algorithms to real-world inspired use cases.

**Reference Books:**

1. Michael A. Nielsen & Isaac L. Chuang – *Quantum Computation and Quantum Information*, Cambridge University Press.
2. Eleanor G. Rieffel & Wolfgang Polak – *Quantum Computing: A Gentle Introduction*, MIT Press.
3. David McMahon – *Quantum Computing Explained*, Wiley.

**Online Learning Resources/Virtual Labs:**
IBM Qiskit Textbook – https://qiskit.org/learn
Coursera – *Introduction to Quantum Computing* (University of Toronto / University of London).
edX – *Quantum Computing Fundamentals and Quantum Algorithms* (MIT / Delft).

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination.

**Minors**

## 23MDINS105 QUANTUM MACHINE LEARNING (QML)

| | L | T | P | C |
|---|---|---|---|---|
| **Pre-requisite:** Nil | **3** | **0** | **0** | **3** |

**Course Description:**

This course blends quantum computing with machine learning. Students learn quantum data encoding, supervised and unsupervised quantum algorithms, and hybrid models. Case studies such as quantum-enhanced fraud detection and NLP are included. Practical implementation is done using Qiskit and PennyLane.

**Course Objectives:**

1. Introduce the fundamentals of quantum-enhanced machine learning.
2. Understand quantum data encoding and kernel methods.
3. Explore quantum algorithms for supervised and unsupervised learning.
4. Analyze hybrid quantum-classical architectures.
5. Implement QML models using frameworks like Qiskit and PennyLane.

**UNIT I INTRODUCTION TO QML** **9 hours**

Need for QML: Why quantum for ML?,Classical vs quantum machine learning, Quantum states as information carriers, Data encoding: amplitude, angle, basis encoding, Introduction to quantum feature space.

**UNIT II QML ALGORITHMS – SUPERVISED LEARNING** **9 hours**

Quantum classifiers (quantum SVMs, qNN), Quantum perceptron, Variational quantum classifiers (VQC), Quantum kernels, Cost functions in quantum models.

**UNIT III QML ALGORITHMS – UNSUPERVISED LEARNING** **9 hours**

Quantum k-means and clustering, Quantum PCA, Quantum generative models (QGANs), Dimensionality reduction and similarity metrics, Performance analysis and limitations.

**UNIT IV HYBRID MODELS & OPTIMIZATION** **9 hours**

Variational Quantum Circuits (VQCs), Hybrid quantum-classical training loops, Barren plateaus and optimization issues, Quantum gradient descent and parameter shift rule, Comparative study of classical and QML models.

**UNIT V QML TOOLS AND CASE STUDIES** **9 hours**

Implementing QML with Qiskit Machine Learning, PennyLane and TensorFlow Quantum integration, Case studies: quantum-enhanced fraud detection, NLP, Quantum datasets and benchmark models, Project: design a small QML application.

**Course Outcomes:**

At the end of this course students will demonstrate the ability to

**CO1:** Understand foundations of quantum machine learning

**CO2:** Apply QML algorithms to datasets

**CO3:** Analyze quantum kernels, data encoding, and models

**CO4;** Evaluate hybrid quantum-classical models

**CO5:** Create and simulate QML models using frameworks

## Text Books:

1. Maria Schuld, Francesco Petruccione – *Machine Learning with Quantum Computers*, Springer
2. Peter Wittek – *Quantum Machine Learning: What Quantum Computing Means to Data Mining*, Academic Press

## Reference Books:

1. Jacob Biamonte – *Quantum Machine Learning*, Nature, 2017
2. Seth Lloyd – *Quantum algorithms for supervised/unsupervised learning* (Research papers)
3. VojtěchHavlíček – *Supervised Learning with Quantum-Enhanced Feature Spaces*, Nature, 2019

**Online Courses & Resources:**

| | | |
|---|---|---|
| **edX** | *Quantum Machine Learning* by UTS | edX Course |
| **Qiskit** | *Qiskit Machine Learning Module* | Qiskit ML |
| **Xanadu** | *QML with PennyLane (Free online textbook)* | PennyLane QML Book |
| **Coursera** | *Quantum Machine Learning* by University of Toronto | Coursera |

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

# Minor in Quantum Technology

## (Applicable to CE, EEE, ME, ECE, CSE, CST, CSE (AI), CSE (DS), CSE (CS), CSE (AI and ML) and CSE (Networks))

**Minor**

## 23MDINS106 FOUNDATIONS OF QUANTUM TECHNOLOGIES

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** Nil

**Course Description:**

This course introduces the fundamental principles of quantum mechanics and their application in quantum information science. It covers the mathematical foundations, including linear algebra and complex vector spaces, to describe quantum states and operators. Key topics include superposition, measurement, entanglement, and quantum dynamics, along with the probabilistic nature of quantum systems. The course also explores practical aspects of quantum technologies, such as qubits, quantum logic gates, decoherence, and basic quantum circuit modeling using simulation tools. By the end, students will gain both theoretical understanding and foundational skills for working with quantum systems and emerging quantum technologies.

**Course Objectives:**

1. Introduce the fundamental quantum mechanics concepts essential for quantum technologies.
2. Build strong mathematical foundations for quantum state modeling.
3. Develop understanding of superposition, entanglement, and measurement.
4. Explain the physical principles behind quantum devices.
5. Prepare students for advanced studies in quantum computation, communication, sensing, and materials.

**UNIT I: QUANTUM MECHANICS FOUNDATIONS** **9 hours**

Classical vs Quantum systems, Wave-particle duality, Schrödinger equation (Time-dependent and Time-independent), Postulates of Quantum Mechanics, Quantum states and state vectors, Complex Hilbert spaces, Dirac notation (Bra-Ket notation), Probabilistic interpretation of quantum mechanics.

**UNIT II: LINEAR ALGEBRA FOR QUANTUM SYSTEMS** **9 hours**

Complex vector spaces and inner products, Orthonormal basis and orthogonality, Linear operators and transformations, Unitary operators and Hermitian operators, Tensor products for multi-qubit systems, Eigenvalues and Eigenvectors, Commutators and anti-commutators, Representing quantum states with matrices.

**UNIT III: SUPERPOSITION, MEASUREMENT, AND ENTANGLEMENT 9 hours**

Principle of superposition, Measurement postulate, Probability amplitudes and Born rule, State collapse upon measurement, Entanglement and Bell states, EPR paradox and non-locality, Density matrices and mixed states, Quantum decoherence.

**UNIT IV: OPERATORS AND QUANTUM DYNAMICS 9 hours**

Time evolution operators, Hamiltonian and energy eigenstates, Quantum harmonic oscillator (brief overview), Unitary evolution and Schrödinger equation solutions, Quantum tunnelling, Adiabatic theorem basics, Operator algebra in quantum systems, Expectation values and observables.

**UNIT V: QUANTUM TECHNOLOGIES BUILDING BLOCKS 9 hours**

Basic qubit systems (spin-1/2, photon polarization, superconducting qubits), Two-level quantum systems modelling, Bloch sphere representation, Quantum logic gates fundamentals, Multi-qubit systems: controlled operations, Introduction to decoherence and quantum error correction, Quantum technologies: hardware platforms overview, Basic quantum circuit modeling using simulators (Qiskit or Q# demo examples).

**Course Outcomes:**

On successful completion of the course, the student will be able to:

CO1: Understand postulates of quantum mechanics for quantum technologies

CO2: Apply linear algebra and Dirac notation to quantum state analysis

CO3: Analyze superposition, entanglement, and measurement processes

CO4: Evaluate quantum systems through operators and probability amplitudes

CO5: Create mathematical models for simple quantum systems

**Textbooks:**

1□. Michael A. Nielsen & Isaac L. Chuang – Quantum Computation and Quantum Information

2□. N. David Mermin – Quantum Computer Science: An Introduction

3□. David McMahon – Quantum Computing Explained (Wiley)

**Reference Books**

1□. Griffiths, D. – Introduction to Quantum Mechanics

2□. Sakurai, J.J. – Modern Quantum Mechanics

3□. ohnWatrous – The Theory of Quantum Information

4□. V.K. Krishnan – Linear Algebra and its Applications to Quantum Computing

**Online Courses & Resources**

| **Platform** | **Course Title** |
|---|---|
| MIT OpenCourseWare | Quantum Physics I, II (MIT OCW 8.04 & 8.05) |
| edX (Berkeley) | Quantum Mechanics and Quantum Computation |

**Mode of Evaluation:** Assignments, Mid Term Tests, End Semester Examination

**Minor**

## 23MDINS107 SOLID STATE PHYSICS FOR QUANTUM TECHNOLOGIES

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** Nil

**Course Description:**

This course provides a comprehensive understanding of the fundamental materials science and physics concepts essential for quantum technologies. It covers crystal structures, electronic properties, and semiconductor physics relevant to quantum devices, including quantum wells, dots, and superconductors. Students will explore quantum confinement in low-dimensional systems, lattice vibrations, phonon interactions, and their impact on qubit performance. The course also examines advanced materials for quantum technologies, such as topological insulators, NV centers, and photonic crystals, along with fabrication challenges and design strategies for achieving long coherence times.

**Course Objectives:**

1. Understand fundamental solid-state physics principles relevant to quantum technologies.
2. Study the electronic properties of materials used in quantum hardware.
3. Explore quantum confinement and nanostructures for qubit implementation.
4. Analyze crystal structures, band theory, and defects influencing quantum devices.
5. Build foundations for material selection and engineering for quantum systems.

**UNIT I: CRYSTAL STRUCTURE AND ELECTRONIC PROPERTIES 9 hours**

Crystal lattices and unit cells, Bravais lattices, Miller indices, Reciprocal lattice and Brillouin zones, Atomic bonding in solids (covalent, ionic, metallic, van der Waals), X-ray diffraction and crystal structure determination, Electronic structure of solids, Free electron theory, Energy bands: metals, semiconductors, and insulators.

**UNIT II: SEMICONDUCTOR PHYSICS FOR QUANTUM DEVICES 9 hours**

Intrinsic and extrinsic semiconductors, Charge carriers: electrons, holes, effective mass, Carrier concentration and Fermi level, p-n junctions and semiconductor heterostructures, Quantum wells and quantum dots as qubits, Superconductors and Josephson junctions, Semiconductor fabrication basics, Materials for quantum hardware: Si, GaAs, diamond NV centers, topological insulators.

**UNIT III: QUANTUM CONFINEMENT AND LOW-DIMENSIONAL SYSTEMS 9 hours**

Quantum size effects: nanowires, nanotubes, 2D materials, Quantum dots: discrete energy levels, Quantum Hall effect, Topological quantum materials, Spintronics and spin qubits, Quantum confinement in superconducting qubits, Heterostructure-based quantum devices, Valleytronics and emerging 2D materials ($MoS_2$ , graphene).

**UNIT IV: LATTICE VIBRATIONS AND PHONON INTERACTIONS 9 hours**

Lattice vibrations and phonons, Heat capacity and thermal conductivity of solids, Electron-phonon interaction, Decoherence in solid-state qubits due to phonons, Magnetic impurities and Kondo effect, Defects and dislocations in crystals, Dopants and quantum impurity systems, Nuclear spin environments and coherence times.

**UNIT V: MATERIALS FOR QUANTUM TECHNOLOGIES 9 hours**

Material engineering for superconducting qubits, NV centers in diamond for quantum sensing, Topological materials for robust qubits, Photonic crystal materials for optical qubits, Hybrid quantum systems: coupling different materials, Fabrication challenges and material purity, Advances in quantum materials research, Designing material systems for long coherence time.

**Course Outcomes:**

On successful completion of the course, the student will be able to:

**CO1:** Understand crystal structures and band theory

**CO2:** Apply knowledge of semiconductors, insulators, and conductors in quantum materials

**CO3:** Analyze quantum confinement effects and low-dimensional systems

**CO4:** Evaluate defects, phonons, and interactions in solid-state systems

**CO5:** Create models for quantum device material systems

**Textbooks:**

1□. Charles Kittel – Introduction to Solid State Physics

2. Michael A. Nielsen & Isaac Chuang – Quantum Computation and Quantum Information

3□. Simon L. Altmann – Band Theory of Solids

**Reference Books**

1. Ashcroft &Mermin – Solid State Physics

2. Yu & Cardona – Fundamentals of Semiconductors: Physics and Materials Properties

3. David Awschalom – Semiconductor Spintronics and Quantum Computation

4. Dieter Vollhardt – Introduction to the Theory of Many-Body Systems

**Online Courses & Resources**

| **Platform** | **Course Title** |
|---|---|
| MIT OpenCourseWare | Solid State Physics (MIT 8.231) |
| edX | Quantum Materials and Devices (U. Tokyo) |
| Coursera | Quantum Materials (ÉcolePolytechnique) |

**Mode of Evaluation:** Assignments, Mid Term Tests, End Semester Examination

**Minor**

## 23MDINS203 QUANTUM DEVICES AND MATERIALS LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Pre-requisite:** Nil

**Course Objectives:**

1. Simulate quantum devices and materials behavior.
2. Explore quantum optics and solid-state quantum systems.
3. Model quantum dots, superconductors, and photonic devices.
4. Perform quantum simulation of condensed matter systems.
5. Build foundational skills for quantum hardware understanding.

**List of Experiments (12 Experiments)**

1. Simulation of Single-Qubit Optical Devices
2. Modeling Quantum Dots and Energy Level Transitions
3. Simulation of Two-Level Atom and Rabi Oscillations
4. Quantum Harmonic Oscillator: Energy Levels Visualization
5. Spin-1/2 Systems and Magnetic Resonance Simulation
6. Superconducting Qubits Circuit Simulation
7. Josephson Junction Modeling for Quantum Circuits
8. Quantum Photonic Interferometer Simulation
9. Simulation of NV Centers in Diamond for Quantum Sensing
10. Solid-State Quantum Materials Simulation (Band Structures)
11. Modeling Quantum Light-Matter Interactions (Jaynes-Cummings Model)

**Platforms & Tools:**

1. QuTiP (Quantum Toolbox in Python)
2. Qiskit Nature / Qiskit Metal
3. MATLAB Simulink
4. COMSOL Multiphysics (for materials simulation)
5. Silvaco TCAD (for device-level modeling)

**Mode of Evaluation:** Continuous Internal Evaluation, Model Test and End Semester Examination.

**Minor**

## 23MDINS108 INTRODUCTION TO QUANTUM COMMUNICATION

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** Nil

**Course Description:**

This course provides a comprehensive introduction to quantum communication principles, technologies, and protocols. It covers the fundamental differences between classical and quantum communication, including quantum entanglement, qubits, and quantum information security. Key topics include Quantum Key Distribution (QKD) protocols, quantum teleportation, and entanglement distribution techniques for secure and long-distance communication. Students will explore quantum networks, quantum internet architecture, and advanced quantum communication applications such as quantum secure direct communication, quantum secret sharing, and post-quantum cryptography. The course also discusses practical implementation challenges, hybrid quantum-classical models, and emerging trends shaping the future of quantum communication.

**Course Objectives:**

1. Introduce fundamental principles of quantum communication.
2. Study quantum key distribution (QKD) protocols.
3. Analyze quantum teleportation, entanglement swapping, and quantum repeaters.
4. Evaluate quantum security principles and their advantages.
5. Prepare students for designing secure communication protocols for future quantum networks.

### UNIT I: INTRODUCTION TO QUANTUM COMMUNICATION 9 hours

Classical communication vs quantum communication, No-cloning theorem and quantum information security, Qubits and qubit transmission channels, Quantum entanglement fundamentals, EPR paradox and Bell's inequalities, Quantum states and measurement, Role of superposition and measurement collapse, Overview of quantum internet and its architecture.

### UNIT II: QUANTUM KEY DISTRIBUTION (QKD) PROTOCOLS 9 hours

Classical cryptography limitations, BB84 protocol, B92 protocol, E91 entanglement-based protocol, Decoy-state QKD, Device-independent QKD, Practical implementation challenges in QKD, Experimental QKD systems (fiber, free-space, satellites).

**UNIT III: QUANTUM TELEPORTATION AND ENTANGLEMENT DISTRIBUTION**

**9 hours**

Quantum teleportation protocol, Entanglement swapping, Quantum repeaters for long-distance communication, Error sources in quantum teleportation, Resource requirements for teleportation, Entanglement purification techniques, Bell state measurements, Applications of teleportation in distributed quantum computing.

**UNIT IV: QUANTUM NETWORKS AND QUANTUM INTERNET** **9 hours**

Architecture of quantum networks, Quantum routers and switching, Quantum memories and storage nodes, Distributed entanglement generation and management, Multiparty quantum communication Blind quantum computing, Performance metrics for quantum networks (fidelity, key rate), Challenges in large-scale quantum network deployment.

**UNIT V: ADVANCED QUANTUM COMMUNICATION PROTOCOLS AND APPLICATIONS** **9 hours**

Quantum secure direct communication, Quantum digital signatures, Position-based quantum cryptography, Quantum secret sharing, Post-quantum cryptography overview, Quantum cloud communication protocols, Building hybrid quantum-classical communication models, Future directions in quantum communication technology.

**Course Outcomes:**

On successful completion of the course, the student will be able to:

**CO1:** Understand quantum communication concepts

**CO2:** Apply quantum entanglement to communication protocols

**CO3:** Analyze QKD protocols and teleportation mechanisms

**CO4:** Evaluate security of quantum communication

**CO5:** Design quantum communication networks and protocols

**Textbooks:**

1. M. Nielsen & I. Chuang – Quantum Computation and Quantum Information

2. Mark M. Wilde – Quantum Information Theory

3. Scarani – Quantum Cryptography: A Primer

**Reference Books**

1. VedranDunjko – Introduction to Quantum Communication and Cryptography

2. Norbert Lütkenhaus – Practical Security in Quantum Key Distribution

3. David McMahon – Quantum Computing Explained

4. Bouwmeester et al. – The Physics of Quantum Information

**Online Courses & Resources**

| Platform | Course Title |
|---|---|
| edX | Quantum Cryptography (ETH Zurich) |
| Coursera | Quantum Communication (Delft University of Technology) |
| MIT | OpenCourseWare Quantum Information Science (MIT 6.443) |
| YouTube | Quantum Internet & Quantum Networking Tutorials |
| IBM Qiskit | Qiskit tutorials on quantum teleportation and QKD |

**Mode of Evaluation:** Assignments, Mid Term Tests, End Semester Examination

**Minor**

## 23MDINS109 INTRODUCTION TO QUANTUM SENSING

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** Nil

**Course Description:**

This course provides a comprehensive introduction to the principles and technologies of quantum sensing and metrology, highlighting how quantum phenomena such as superposition, entanglement, and squeezing enable precision measurements beyond classical limits. Students will explore fundamental concepts like the Standard Quantum Limit, Heisenberg limit, and quantum phase estimation, along with key measurement techniques including quantum interferometry, atomic clocks, magnetometry, and quantum imaging. The course also covers noise sources, decoherence, and error mitigation strategies, and examines cutting-edge applications in navigation, medical imaging, environmental monitoring, and space-based sensing. By the end, learners will gain both theoretical understanding and practical insight into the design and operation of advanced quantum sensor systems.

**Course Objectives:**

1. Introduce the principles of quantum sensing and metrology.
2. Explain how quantum superposition and entanglement enhance measurement sensitivity.
3. Study applications of quantum sensors across multiple domains.
4. Analyze noise, decoherence, and quantum limits on measurement.
5. Prepare students to design and analyze quantum-enhanced sensors.

**UNIT I: INTRODUCTION TO QUANTUM SENSING AND METROLOGY 9 hours**

Classical vs quantum sensing, Precision limits: Standard Quantum Limit (SQL), Quantum metrology fundamentals, Heisenberg limit, Quantum phase estimation for precision measurements, Quantum non-demolition measurements, Quantum error correction in sensing, Importance of coherence and entanglement in sensors.

**UNIT II: QUANTUM MEASUREMENT PRINCIPLES** **9 hours**

Superposition and interference in measurement, Quantum Fisher information, Squeezed states for noise reduction, Photon counting and single-photon detectors, Spin-based measurements (NV centers, trapped ions), Ramsey interferometry, Quantum state tomography, Applications of quantum-enhanced interferometry.

**UNIT III: QUANTUM SENSOR TECHNOLOGIES** **9 hours**

Atomic clocks (optical & microwave), Gravimeters and accelerometers, Magnetometers (SQUIDs, NV centers), Quantum gyroscopes, Quantum imaging & super-resolution microscopy, Quantum lidar and radar, Force and electric field sensing, Photonic quantum sensing systems.

**UNIT IV: DECOHERENCE, NOISE, AND ERROR MITIGATION IN QUANTUM SENSING** **9 hours**

Sources of decoherence in quantum sensors, Thermal noise and quantum noise sources, Quantum back-action, Squeezing and noise reduction techniques, Dynamical decoupling techniques, Noise spectroscopy for sensor calibration, Robust error mitigation protocols, Evaluating sensitivity vs noise tradeoffs.

**UNIT V: ADVANCED APPLICATIONS AND FUTURE QUANTUM SENSING SYSTEMS** **9 hours**

Quantum sensing for biological and medical imaging, Navigation and positioning without GPS, Quantum-enhanced gravitational wave detection (LIGO), Quantum-enhanced environmental monitoring, Sensors for national defense and security, Space-based quantum sensors, Integrated quantum photonic sensing platforms, Design of hybrid quantum-classical sensor systems.

**Course Outcomes:**

On successful completion of the course, the student will be able to:

**CO1:** Understand the basic principles of quantum sensing

**CO2:** Apply quantum superposition and entanglement to sensing

**CO3:** Analyze quantum sensor architectures

**CO4:** Evaluate sensitivity and error limits in quantum measurements

**CO5:** Design quantum sensing systems for real-world applications

**Textbooks:**

1□. Christian L. Degen, F. Reinhard, P. Cappellaro – Quantum Sensing

2□. Giovannetti, Lloyd &Maccone – Advances in Quantum Metrology

3□. David Budker& Derek F. Jackson Kimball – Optical Magnetometry

**Reference Books**

1□. Kurt Jacobs – Quantum Measurement Theory and its Applications

2□. Helmut Rauch – Neutron Interferometry

3□. M. O. Scully & M. S. Zubairy – Quantum Optics (Chapters on Metrology)

4□. VlatkoVedral – Introduction to Quantum Information Science

**Online Courses & Resources**

| **Platform** | **Course Title** |
|---|---|
| edX | Quantum Sensing & Metrology (LMU Munich) |
| Coursera | Quantum Optics and Sensing (University of Colorado Boulder) |
| MIT OpenCourseWare | Quantum Measurement and Sensing (MIT) |
| YouTube | Quantum Sensing Lectures |
| IBM Qiskit | Tutorials on Quantum Phase Estimation |

**Mode of Evaluation:** Assignments, Mid Term Tests, End Semester Examination

**Minor**

**23MDINS204 QUANTUM COMMUNICATION AND SENSING LABORATORY**

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Pre-requisite:** Nil

**Course Objectives:**

1. Simulate and analyze quantum communication protocols.
2. Implement quantum key distribution (QKD) and teleportation.
3. Perform quantum sensing simulations for precision measurements.
4. Evaluate sensor performance with noise and decoherence.
5. Gain hands-on experience with quantum simulation tools.

**List of Experiments (12 Experiments)**

1. Simulation of Qubits and Bloch Sphere Visualization
2. Implementation of BB84 Quantum Key Distribution Protocol
3. Simulation of B92 and E91 QKD Protocols
4. Quantum Entanglement Generation and Bell Inequality Testing
5. Quantum Teleportation Protocol using Qiskit/Cirq
6. Simulation of Quantum Repeaters and Entanglement Swapping
7. Noise and DecoherenceModeling in Quantum Communication Channels
8. Ramsey Interferometry Simulation for Quantum Sensing
9. Implementation of NV CenterMagnetometry Simulation
10. Quantum Gravimeter and Accelerometer Simulation
11. Quantum Phase Estimation for High-Precision Metrology

**Platforms & Tools:**

1. IBM Qiskit
2. Google Cirq
3. RigettiPyQuil
4. Quantum Inspire
5. MATLAB / Python with quantum libraries

**Mode of Evaluation:** Continuous Internal Evaluation, Model Test and End Semester Examination.

**Minor**

## 23MDINS110 QUANTUM OPTICS PREREQUISITES FOR QUANTUM TECHNOLOGIES

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** Nil

**Course Description:**

This course introduces the fundamental principles and applications of quantum optics and photonics. It covers the classical and quantum description of light, electromagnetic field quantization, and light–matter interactions. Topics include coherence theory, quantum noise, and advanced phenomena such as photon antibunching, squeezing, and cavity-QED. The course also explores emerging quantum photonics technologies, including single-photon sources, entangled photon generation, quantum key distribution, and quantum metrology, preparing students for research and experimentation in modern quantum optics.

**Course Objectives:**

1. Introduce fundamentals of light-matter interaction relevant for quantum technologies.
2. Explain the quantization of electromagnetic fields.
3. Study the role of photons as quantum information carriers.
4. Explore coherent states, squeezed states, and single-photon sources.
5. Prepare for quantum sensing, communication, and photonic quantum computing applications.

**UNIT I: CLASSICAL AND QUANTUM DESCRIPTION OF LIGHT 9 hours**

Review of electromagnetic waves, Maxwell‘s equations for light propagation, Plane waves, polarization, Poynting vector, Classical interference, diffraction, coherence, Blackbody radiation & Planck's hypothesis, Photoelectric effect, Photons as quantized light energy, Introduction to quantum theory of radiation.

**UNIT II: QUANTIZATION OF ELECTROMAGNETIC FIELD 9 hours**

Harmonic oscillator quantization, Field quantization in free space, Photon number (Fock) states, Coherent states and classical-quantum correspondence, Vacuum fluctuations and zero-point energy, Single-mode vs multi-mode quantization, Spontaneous and stimulated emission, Quantum field operators and commutation relations.

**UNIT III: LIGHT-MATTER INTERACTION** **9 hours**

Two-level atom model, Absorption, stimulated emission, spontaneous emission, Einstein coefficients, Rabi oscillations, Jaynes-Cummings model, Resonant and non-resonant interaction, Cavity Quantum Electrodynamics (Cavity-QED), Atom-photon entanglement.

**UNIT IV: QUANTUM COHERENCE AND QUANTUM NOISE** **9 hours**

Classical vs quantum coherence, First- and second-order coherence functions, Photon antibunching, Hanbury Brown and Twiss experiment, Quantum squeezing of light, Phase-sensitive amplification, Quantum noise, shot noise, and standard quantum limit, Quantum nondemolition measurements.

**UNIT V: QUANTUM PHOTONICS APPLICATIONS** **9 hours**

Single-photon sources (quantum dots, NV centers, SPDC), Entangled photon pair generation, Photonic qubits and linear optical quantum computing, Quantum key distribution with photons, Photonic integrated circuits, Quantum sensors based on squeezed light, Quantum metrology using entangled photons, Designing experiments for quantum optics labs.

**Course Outcomes:**

On successful completion of the course, the student will be able to:

**CO1:** Understand quantum nature of light

**CO2:** Apply Maxwell‘s equations to optical fields

**CO3:** Analyze interaction of photons with matter

**CO4:** Evaluate coherence, squeezing, and quantum noise

**CO5:** Create models for photonic quantum systems

**Textbooks:**

1 Mark Fox – Quantum Optics: An Introduction

2. Rodney Loudon – The Quantum Theory of Light

3. M. O. Scully & M. S. Zubairy – Quantum Optics

**Reference Books**

1. Stephen Barnett – Quantum Information

2. Peter Meystre – Elements of Quantum Optics

3. Michel Le Bellac – Quantum Physics

4. D. F. Walls & G. J. Milburn – Quantum Optics

**Online Courses & Resources**

| Platform | Course Title |
|---|---|
| MIT OpenCourseWare | Quantum Optics (MIT 8.421) |
| edX | Principles of Photonics (EPFL) |
| Coursera | Quantum Optics 1 & 2 (U. Rochester) |
| YouTube | Quantum Optics Lectures (Various universities) |

**Mode of Evaluation:** Assignments, Mid Term Tests, End Semester Examination

# Honors in Mechanical Engineering

**Honors**

## 23HDME101 ADVANCED WELDING TECHNOLOGY

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** **23ME106 MANUFACTURING TECHNOLOGY**

**Course Objectives:**

This course is designed to:

1. Provide in-depth knowledge of advanced welding processes such as LBW, EBW, FSW, and solid-state methods.
2. Impart understanding of welding metallurgy, microstructural transformations, and weldability of materials.
3. Introduce thermal modeling and simulation in welding to predict cooling rates and mechanical properties.
4. Analyze welding defects, inspection, and testing methods following industrial standards.
5. Explore principles of weld joint design, automation, and applications in industries like aerospace and automotive.

**UNIT I ADVANCED WELDING PROCESSES 9 hours**

Laser Beam Welding (LBW), Electron Beam Welding (EBW), Ultrasonic Welding (USW), Friction Stir Welding (FSW), Explosion Welding, Diffusion Welding and Solid-State Welding Processes

**UNIT II WELDING METALLURGY AND WELDABILITY 9 hours**

Heat Affected Zone (HAZ), Weld metal solidification, Microstructural changes during welding, Preheating and Post-weld heat treatment (PWHT), Weldability of Ferrous and Non-Ferrous Alloys

**UNIT III THERMAL MODELING AND SIMULATION OF WELDING PROCESSES 9 hours**

Governing heat transfer equations and boundary conditions for various types of welding processes. Estimation of cooling rates. Prediction of mechanical properties

**UNIT IV WELDING DEFECTS, TESTING AND INSPECTION 9 hours**

Types of welding defects, causes and remedies, Destructive testing methods (Tensile, Bend, Impact), Non-destructive testing (NDT): Radiographic, Ultrasonic, Magnetic Particle, Dye Penetrant, Codes and standards (ASME, AWS, ISO)

**UNIT V WELDING DESIGN, AUTOMATION AND APPLICATIONS 9 hours**

Weld joint design principles, Residual stresses and distortion control, Fixtures for welding, Welding automation, sensors, and robotics, Case studies: Automotive, Aerospace, Pressure Vessels

**Course Outcomes:**

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

CO1: Understand the working principles, equipment, and applications of modern and solid-state welding processes. (L2)

CO2: Analyze metallurgical transformations, heat-affected zones, and weldability of various engineering alloys. (L4)

CO3: Formulate and solve thermal models of welding processes to predict temperature fields and material behavior. (L3)

CO4: Identify welding defects and select appropriate destructive and non-destructive testing techniques. (L3)

CO5: Apply concepts of welding design and automation to real-world industrial applications. (L3)

**Text Books:**

1. Parmar, R.S., Welding Engineering and Technology, Khanna Publishers, 2010.
2. Little, R.L., Welding and Welding Technology, Tata McGraw Hill, 2004.
3. Cary, H.B. & Helzer, S.C., Modern Welding Technology, 6th Edition, Pearson Education, 2005.

**Reference Books:**

1. ASM Handbook Vol. 6, Welding, Brazing and Soldering, ASM International, 1993.
2. AWS Welding Handbook, American Welding Society, Volumes 1–4.
3. J.F. Lancaster, Metallurgy of Welding, 2007.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Honors**

## 23HDME102 PRODUCT DESIGN DEVELOPMENT

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** **None**

**Course Objectives:**

This course is designed to:

1. Introduce students to structured approaches in product design and development.
2. Enhance creativity and analytical skills for concept generation and evaluation.
3. Teach the integration of engineering, aesthetic, ergonomic, and economic considerations.
4. Promote sustainable, user-centered design and rapid prototyping practices.
5. Develop a holistic understanding of product life cycle, cost, and innovation management.

**UNIT I INTRODUCTION TO PRODUCT DESIGN AND INNOVATION 9 hours**

Overview of product design, development, and innovation. Types of products – industrial, consumer, and engineered systems. Role of design in business strategy. Product life cycle, market-driven innovation, and emerging trends. Product architecture and modularity.

**UNIT II PRODUCT DEVELOPMENT PROCESS AND PLANNING 9 hours**

Phases of product development – opportunity identification, concept development, system-level design, detail design, and testing. Cross-functional teams and organizational structure. Planning for product platforms and variants. Identification of customer needs and benchmarking.

**UNIT III CONCEPT GENERATION AND SELECTION 9 hours**

Structured methods for concept generation – brainstorming, morphological charts, TRIZ, and SCAMPER. Concept screening and scoring matrices. Decision-making under uncertainty. Creative problem-solving tools and idea evaluation frameworks.

**UNIT IV EMBODIMENT DESIGN AND PROTOTYPING 9 hours**

Design for manufacturing and assembly (DFMA). Embodiment design principles – material selection, strength, ergonomics, and aesthetics. Types of prototypes – visual, functional, working, and pre-production. Rapid prototyping techniques and validation.

**UNIT V DESIGN ECONOMICS AND SUSTAINABILITY 9 hours**

Cost estimation, value engineering, and life cycle cost analysis. Risk analysis and design failure modes. Sustainability in product design – eco-friendly materials, design for reuse/recycle. Case studies on successful and failed product designs. Intellectual property basics – patents, copyrights, and trademarks.

**Course Outcomes:**

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

CO1: Describe the product development process and identify key phases in the life cycle. (L2)

CO2: Generate and evaluate innovative design concepts using structured methodologies. (L4)

CO3: Apply embodiment design principles for manufacturability, usability, and performance. (L3)

CO4: Develop basic prototypes and assess their functionality and design improvements. (L4)

CO5: Analyze product cost, value, and sustainability to support strategic design decisions. (L4)

**Text Books:**

1. Ulrich, K.T. & Eppinger, S.D., Product Design and Development, 7th Edition, McGraw Hill, 2023.
2. Pugh, S., Total Design: Integrated Methods for Successful Product Engineering, 2022 Reprint, Pearson.
3. Otto, K. & Wood, K., Product Design: Techniques in Reverse Engineering and New Product Development, 2nd Edition, Pearson, 2023.

**Reference Books:**

1. Cross, N., Engineering Design Methods: Strategies for Product Design, 5th Edition, Wiley, 2022.
2. Chitale, A.K. & Gupta, R.C., Product Design and Manufacturing, 6th Edition, PHI Learning, 2023.
3. IDEO, The Field Guide to Human-Centered Design, IDEO.org, 2023 Edition.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Honors**

## 23HDME201 ADVANCED WELDING LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Pre-requisite: None**

**Course Objectives:**

This course is designed to:

1. Provide hands-on training in advanced arc and non-arc welding processes.
2. Familiarize students with the setup, parameters, and control systems of various welding machines.
3. Develop skills for joining difficult materials and dissimilar metals.
4. Introduce testing and inspection methods for weld quality assurance.
5. Cultivate an understanding of microstructural and mechanical behavior of welds.

**List of Experiments:**

1. Study and demonstration of TIG and MIG welding setups, identifying control parameters and consumables.
2. Welding practice using Tungsten Inert Gas (TIG) on stainless steel and aluminum plates.
3. Welding practice using Metal Inert Gas (MIG) on low carbon and alloy steels.
4. Execution of weld bead deposition using Submerged Arc Welding (SAW) and observation of flux behavior.
5. Hardfacing or cladding using Gas Metal Arc Welding (GMAW) for wear-resistant applications.
6. Dissimilar metal welding between ferrous and non-ferrous materials using advanced processes.
7. Laser Beam Welding (LBW) or Plasma Arc Welding (PAW) demonstration and microstructure study.
8. Measurement and analysis of weld defects using visual inspection and dye penetrant testing.
9. Macro and microstructure examination of welded specimens using metallographic techniques.
10. Evaluation of mechanical properties of weld joints – tensile, bend, or impact test.

**Course Outcomes:**

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

CO1: Demonstrate proficiency in operating advanced welding equipment including TIG, MIG, and SAW. (L3)

CO2: Perform welding on various metals and apply techniques for achieving quality welds. (L3)

CO3: Identify weld defects using visual and non-destructive testing techniques. (L4)

CO4: Examine macro and microstructural changes in weld zones and correlate with mechanical properties. (L4)

CO5: Document welding procedures and interpret testing data for weld performance evaluation. (L4)

**Reference Books:**

1. Lab manual provided by the department.

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination

**Honors**

## 23HDME103 REFRIGERATION SYSTEM DESIGN

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** None

**Course Objectives:**

This course is designed to:

1. Introduce principles and classifications of refrigeration systems.
2. Equip students with design techniques for vapor compression systems and components.
3. Enable refrigerant selection based on thermophysical and environmental properties.
4. Explain the role of system accessories and controls in performance and safety.
5. Develop skills to analyze, evaluate, and optimize modern refrigeration systems.

**UNIT I FUNDAMENTALS OF REFRIGERATION 9 hours**

Introduction to refrigeration – definition, applications, and classifications. Review of thermodynamic principles and refrigeration effect. Analysis of vapor compression refrigeration (VCR) cycle and reversed Carnot cycle. Comparison with air refrigeration and vapor absorption systems.

**UNIT II DESIGN OF VAPOR COMPRESSION SYSTEMS 9 hours**

Component design – compressor selection, condenser sizing, expansion device, and evaporator design. Effects of superheating, subcooling, and pressure drops. Use of psychrometrics in refrigeration. Calculation of cooling load and selection of refrigerants based on environmental impact.

**UNIT III REFRIGERANTS AND ENVIRONMENTAL ASPECTS 9 hours**

Classification and properties of refrigerants – CFCs, HCFCs, HFCs, and natural refrigerants. Global warming potential (GWP) and ozone depletion potential (ODP). Environmental protocols – Montreal and Kyoto agreements. Alternative eco-friendly refrigerants and refrigerant blends.

**UNIT IV SYSTEM CONTROLS AND ACCESSORIES 9 hours**

Design and functioning of thermostatic expansion valves, capillary tubes, pressure switches, and solenoid valves. Control strategies for variable load conditions. Selection and arrangement of piping systems, driers, receivers, and oil separators. Safety devices and instrumentation.

**UNIT V ADVANCED SYSTEMS AND PERFORMANCE EVALUATION 9 hours**

Multi-stage and cascade refrigeration systems. Low-temperature applications and cryogenics. Performance enhancement techniques – economizers, intercoolers, and ejectors. System simulation using software. Energy efficiency ratio (EER), coefficient of performance (COP), and system optimization.

**Course Outcomes:**

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

CO1: Explain the working of refrigeration cycles and compare different refrigeration systems. (L2)

CO2: Design major components of vapor compression systems for specified cooling requirements. (L4)

CO3: Select appropriate refrigerants considering environmental regulations and thermodynamic performance. (L3)

CO4: Apply control strategies and configure system accessories for safe and efficient operation. (L4)

CO5: Evaluate advanced refrigeration systems using performance metrics and propose optimization methods. (L4)

**Text Books:**

1. Arora, C.P., Refrigeration and Air Conditioning, 4th Edition, McGraw Hill, 2022.
2. Ballaney, P.L., Refrigeration and Air Conditioning, 27th Edition, Khanna Publishers, 2023.
3. Stoecker, W.F. & Jones, J.W., Refrigeration and Air Conditioning, Reprint Edition, McGraw Hill, 2023.

**Reference Books:**

1. Dossat, R.J. & Horan, T.J., Principles of Refrigeration, 6th Edition, Pearson Education, 2022.
2. ASHRAE Handbook, Refrigeration, Latest Edition, ASHRAE, 2023.
3. Manohar Prasad, Refrigeration and Air Conditioning, 3rd Edition, New Age International, 2022.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Honors**

## 23HDME104 INDUSTRIAL TRIBOLOGY AND SURFACE ENGINEERING

| L | T | P | C |
|---|---|---|---|
| 3 | 0 | 0 | 3 |

**Pre-requisite:** None

**Course Objectives:**

This course is designed to:

1. Provide fundamental understanding of friction, wear, and lubrication mechanisms.
2. Develop analytical capability to design tribological systems and components.
3. Introduce surface engineering techniques for performance enhancement.
4. Explore material selection and coating processes for specific industrial needs.
5. Analyze industrial case studies for failure prevention and surface integrity improvement.

**UNIT I FUNDAMENTALS OF TRIBOLOGY 9 hours**

Definition and scope of tribology. Types of contacts – conformal and non-conformal. Surface roughness and measurement techniques. Modes of wear – adhesive, abrasive, corrosive, and fatigue wear. Theories of friction and wear mechanisms in engineering components.

**UNIT II LUBRICATION PRINCIPLES AND APPLICATIONS 9 hours**

Types of lubrication – boundary, mixed, and hydrodynamic. Properties and classification of lubricants. Reynolds equation and its derivation. Design of journal and thrust bearings. Elastohydrodynamic lubrication (EHL) and hydrostatic lubrication. Lubrication regimes and performance maps.

**UNIT III SURFACE ENGINEERING TECHNIQUES 9 hours**

Introduction to surface modification. Surface cleaning and preparation. Coating methods – electroplating, thermal spraying, PVD, CVD, laser cladding. Surface hardening processes – carburizing, nitriding, flame and induction hardening. Selection of surface treatment based on application.

**UNIT IV MATERIALS AND TRIBOLOGICAL DESIGN 9 hours**

Tribological behavior of metals, ceramics, polymers, and composites. Selection of materials for wear resistance. Design strategies for wear reduction and life enhancement. Contact stress analysis. Tribo-design principles in gears, cams, bearings, and cutting tools.

**UNIT V INDUSTRIAL APPLICATIONS AND CASE STUDIES 9 hours**

Tribology in automotive, aerospace, biomedical, and manufacturing systems. Failure analysis due to wear and friction. Condition monitoring and lubrication management. Role of nanotechnology in tribology. Case studies on real-world tribological problems and solutions.

**Course Outcomes:**

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

CO1: Explain the fundamental principles of tribology and types of wear mechanisms. (L2)
CO2: Analyze lubrication regimes and design bearing systems using Reynolds equation. (L4)
CO3: Select appropriate surface modification methods for engineering applications. (L3)
CO4: Evaluate material behavior and surface design strategies for reducing wear and friction. (L4)
CO5: Apply tribological concepts to real-life engineering problems and propose improvements using case studies. (L4)

**Text Books:**

1. Bhushan, B., Introduction to Tribology, 3rd Edition, Wiley, 2023.
2. Sethi, P.D., Lubrication and Maintenance of Industrial Machinery, 2nd Edition, CRC Press, 2022.
3. Stachowiak, G.W. & Batchelor, A.W., Engineering Tribology, 5th Edition, Butterworth-Heinemann, 2021.

**Reference Books:**

1. Hutchings, I.M. & Shipway, P., Tribology: Friction and Wear of Engineering Materials, 3rd Edition, Butterworth-Heinemann, 2023.
2. Neale, M.J., Tribology Handbook, 3rd Edition, Butterworth-Heinemann, 2022.
3. Totten, G.E., Surface Modification and Mechanisms, 2nd Edition, CRC Press, 2023.

**Mode of Evaluation:** Assignments, Mid Term Tests and End Semester Examination.

**Honors**

## 23HDME202 ADVANCED MANUFACTURING TECHNOLOGY LABORATORY

| L | T | P | C |
|---|---|---|---|
| 0 | 0 | 3 | 1.5 |

**Pre-requisite: None**

**Course Objectives:**

This course is designed to:

1. Provide practical exposure to modern CNC machining, additive manufacturing, and hybrid processes.
2. Develop hands-on skills in operating, programming, and simulating advanced manufacturing equipment.
3. Introduce surface and process quality evaluation techniques.
4. Integrate knowledge of sensors, robotics, and automation in a smart manufacturing environment.
5. Enable students to analyze and optimize machining and manufacturing system parameters.

**List of Experiments:**

1. Demonstration and hands-on operation of CNC turning and milling machines using G & M codes.
2. Simulation and verification of CNC part programs using software such as FANUC or Siemens.
3. 3D printing of engineering components using FDM/FFF technology and evaluation of build parameters.
4. Slicing and optimization of STL models for additive manufacturing using slicing software.
5. Measurement of surface roughness and comparison between conventional and non-traditional processes.
6. EDM of Die Steel Materials
7. Laser beam or ultrasonic machining demonstration for micro-features or delicate materials.
8. Force and vibration measurement during machining using dynamometers or sensors.
9. Study of Automated Material Handling Systems

**Course Outcomes:**

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

CO1: Operate CNC machines and simulate tool paths for part manufacturing. (L3)

CO2: Apply additive manufacturing techniques to build and evaluate engineering components. (L4)

CO3: Measure and analyze machining responses such as surface finish, force, and vibration. (L4)

CO4: Demonstrate non-traditional machining techniques and assess their advantages. (L4)

CO5: Integrate automation tools like robots and AGVs into advanced manufacturing workflows. (L4)

**Reference Books:**

1. Lab manual provided by the department.

**Mode of Evaluation**: Continuous Internal Evaluation, Model Test and End Semester Examination