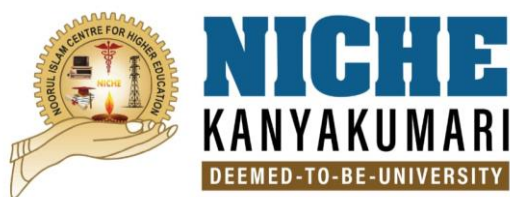


**NOORUL ISLAM CENTRE FOR HIGHER EDUCATION**

**(Deemed to be University Under Section 3 of the UGC Act, 1956)**  
**Kumaracoil, Thuckalay**

**DEPARTMENT OF MECHANICAL ENGINEERING**



**B.E. MECHANICAL ENGINEERING**  
**CURRICULUM AND SYLLABI**

**REGULATION 2021**

# **NOORUL ISLAM CENTRE FOR HIGHER EDUCATION, Kumaracoil**

**Regulation : 2021**

## **Curriculum and Syllabi**

### **DEPARTMENT OF MECHANICAL ENGINEERING**

#### **B.E. MECHANICAL ENGINEERING**

##### **Vision of the University**

To be recognized by the Government and society at large as an institution able to deliver excellence with relevance in the field of higher education and research focusing on the needs of the nation in tune with the technological revolution to cope with the knowledge explosion and global competence.

##### **Mission of the University**

To develop the institution as a Centre of Excellence, keeping pace with the advances in the field, so as to provide quality higher education to the students and instill in them high standards of discipline and ethics so that they become enlightened individuals in the service of humanity and to carry out focused research in the frontier areas of science and technology.

#### **Faculty of Mechanical Engineering**

#### **Department of Mechanical Engineering**

##### **Vision of the Department**

To become a centre of excellence in teaching, research & development by producing innovative and creative mechanical engineers to meet the global challenges.

##### **Mission of the Department**

To achieve National and International recognition by providing educational needs & Industry requirements through unique programs in Mechanical Engineering.

## Description of the programme

Mechanical engineering is an innovative subject that looks at the design, analysis, and manufacturing of systems that keep our world moving forward. The role of a mechanical engineer is to take a product from an idea to the marketplace. To accomplish this, the mechanical engineer must be able to determine the forces and thermal environment that a product, its parts, or its subsystems will encounter; design them for functionality, aesthetics, and durability; and determine the best manufacturing approach that will ensure operation without failure. Mechanical engineers play key roles in a wide range of industries including automotive, aerospace, biotechnology, computers, electronics, micro electromechanical systems, energy conversion, robotics and automation, and manufacturing. The breadth of the mechanical engineering discipline allows students a variety of career options beyond the industries listed above. Regardless of the particular path they envision for themselves, a mechanical engineering education empowers students with creative thinking skills to design an exciting product or system; analytical tools to achieve their design goals; the ability to overcome all constraints; and the teamwork needed to design, market, and produce a system.

| Programme Educational Objectives - PEO |                                                                                                                                    |
|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| PEO-01                                 | To provide students in depth knowledge on basic concepts with a sound understanding of fundamental principles & methods.           |
| PEO-02                                 | To make them understand the core subjects even to persuade higher studies.                                                         |
| PEO-03                                 | To improve the ability to self-learn the modern engineering tools & techniques, skills & engineering practices necessary for work. |
| PEO-04                                 | To develop logical thinking with good communication for having a broad range of knowledge & computing skills to meet the demands.  |
| PEO-05                                 | To develop a reputation as a source of innovative solution to complex problem.                                                     |
| PEO-06                                 | To develop the position of leadership in an organization or on a team.                                                             |
| PEO-07                                 | To gain professionalism to analyze, decide & act by designing and experimenting sophisticated labs with latest software.           |
| PEO-08                                 | To provide services to their profession & community, drawing upon their educational experience to serve the humankind.             |

| <b>Graduate Attributes-GA</b> |                                                                                                                                                                                                                                                               |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>GA-1</b>                   | <b>Innovative Engineering Solutions</b> Develop creative and innovative solutions to complex engineering problems, incorporating the latest technologies and approaches to address current and future challenges.                                             |
| <b>GA-2</b>                   | <b>Global Perspective in Engineering</b> Understand and apply engineering solutions in a global context, recognizing the diversity of global issues, standards, and the impact of engineering decisions on different cultures and communities.                |
| <b>GA-3</b>                   | <b>Sustainable Development and Green Engineering</b> Design and implement engineering solutions that prioritize sustainability, resource efficiency, and environmental protection, contributing to a sustainable future.                                      |
| <b>GA-4</b>                   | <b>Social Responsibility and Community Engagement</b> Demonstrate a commitment to social responsibility by engaging with and contributing to local communities, understanding societal needs, and addressing social challenges through engineering practices. |
| <b>GA-5</b>                   | <b>Adaptability and Lifelong Learning</b> Exhibit a proactive approach to continuous learning and adaptability, keeping pace with technological advancements and industry changes, and engaging in professional development activities.                       |
| <b>GA-6</b>                   | <b>Entrepreneurship and Innovation</b> Foster an entrepreneurial mindset, identifying opportunities for innovation and creating value through new technologies, products, and processes that meet market needs.                                               |
| <b>GA-7</b>                   | <b>Interdisciplinary Collaboration</b> Work effectively in interdisciplinary teams, integrating knowledge from various fields to develop comprehensive solutions to complex engineering problems.                                                             |
| <b>GA-8</b>                   | <b>Ethical Leadership and Integrity</b> Lead with integrity and ethical principles, ensuring transparency, fairness, and respect in all professional and personal interactions.                                                                               |
| <b>GA-9</b>                   | <b>Digital and Data Literacy</b> Utilize advanced digital tools and data analytics techniques to solve engineering problems, optimize processes, and make informed decisions based on data-driven insights.                                                   |
| <b>GA-10</b>                  | <b>Safety, Health, and Risk Management</b> Prioritize safety, health, and risk management in engineering practices, ensuring the well-being of individuals and communities while minimizing potential risks and hazards.                                      |
| <b>GA-11</b>                  | <b>Effective Communication and Negotiation Skills</b> Communicate ideas, solutions, and technical information effectively to a variety of audiences, and engage in negotiation to resolve conflicts and reach consensus.                                      |
| <b>GA-12</b>                  | <b>Impact Assessment and Policy Making</b> Assess the impact of engineering projects on society and the environment, and contribute to policy-making processes that promote sustainable and responsible engineering practices.                                |

| <b>Programme Outcome - PO</b> |                                                                                                                                         |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| PO-A                          | Improve the ability of applying knowledge gained from subjects learned.                                                                 |
| PO-B                          | Increase the ability to design and conduct experiments as well as analyzing and interpreting data.                                      |
| PO-C                          | Increase the ability to design a system, component or process to meet desired needs.                                                    |
| PO-D                          | Increase the ability to familiarize multidisciplinary skills and ethical values.                                                        |
| PO-E                          | Improves personal and social responsibilities to respond human needs like environmental protection.                                     |
| PO-F                          | Engages lifelong learning including the ability to show proficiency in current technologies.                                            |
| PO-G                          | Increases the ability of communicating effectively.                                                                                     |
| PO-H                          | Increases the ability of working collaboratively as a team and serves the role of team leader innovatively.                             |
| PO-I                          | Understanding the impact of engineering solutions in global, economic, environmental & societal context.                                |
| PO-J                          | Ability to demonstrate critical thinking and the usage of appropriate strategies, tools to conduct investigation in appropriate manner. |
| PO-K                          | Improves the skill of applying techniques and modern engineering tools necessary for project development.                               |
| PO-L                          | Understanding management policies/principles and apply those to manage the projects in the context of technological change.             |

#### **Mapping of Graduate Attributes and Programme Educational Objectives(PEO)**

| <b>GAs<br/>PEOs</b> | <b>G<br/>A-<br/>01</b> | <b>GA-<br/>02</b> | <b>GA-<br/>03</b> | <b>GA-<br/>04</b> | <b>GA-<br/>05</b> | <b>GA-<br/>06</b> | <b>GA-<br/>07</b> | <b>GA-<br/>08</b> | <b>GA-<br/>09</b> | <b>GA-<br/>10</b> | <b>GA-<br/>11</b> | <b>GA-<br/>12</b> |
|---------------------|------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| PEO-01              | H                      | A                 | H                 | A                 | A                 | H                 | A                 | A                 | A                 | A                 | A                 | A                 |
| PEO-02              | A                      | A                 | A                 | A                 | A                 | A                 | A                 | A                 | A                 | A                 | A                 | H                 |
| PEO-03              | H                      | A                 | A                 | H                 | H                 | A                 | A                 | A                 | A                 | A                 | A                 | A                 |



|      |   |   |   |   |   |   |   |   |   |   |   |   |
|------|---|---|---|---|---|---|---|---|---|---|---|---|
| PO-J | A | A | A | H | A | A | H | A | A | A | A | A |
| PO-K | A | A | A | A | A | A | A | A | A | H | A | A |
| PO-L | A | A | A | A | A | A | A | A | H | A | A | A |

H- Highly Associated

A- Associated

Not – Not Associated

### Mapping of Programme Educational Objective (PEOs) and Programme Outcomes (POs)

| PEO<br>PO | PEO-01 | PEO-02 | PEO-03 | PEO-04 | PEO-05 |
|-----------|--------|--------|--------|--------|--------|
| PO-A      | H      | A      | H      | A      | A      |
| PO-B      | A      | H      | A      | A      | A      |
| PO-C      | H      | A      | H      | A      | A      |
| PO-D      | A      | H      | A      | A      | A      |
| PO-E      | H      | A      | A      | H      | A      |
| PO-F      | A      | H      | H      | A      | A      |
| PO-G      | A      | A      | A      | H      | A      |
| PO-H      | A      | A      | A      | A      | H      |
| PO-I      | A      | A      | A      | A      | A      |
| PO-J      | A      | A      | A      | H      | A      |

H- Highly Associated

A- Associated

Not – Not Associated

**Duration of the programme:** IV/VIII

**Total credit:** 163

**CURRICULUM & SYLLABI****SEMESTER I**

| <b>Sl. No</b>    | <b>Course Code</b> | <b>Course Title</b>                                         | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|------------------|--------------------|-------------------------------------------------------------|----------|----------|----------|----------|
| <b>THEORY</b>    |                    |                                                             |          |          |          |          |
| 1.               | EG3101             | Technical English                                           | 3        | 1        | 0        | 4        |
| 2.               | MA3101             | Engineering Mathematics – I                                 | 3        | 1        | 0        | 4        |
| 3.               | BS3101             | Engineering Physics                                         | 3        | 0        | 0        | 3        |
| 4.               | BS3102             | Engineering Chemistry                                       | 3        | 0        | 0        | 3        |
| 5.               | CS3101             | Fundamentals of Computing and Python Programming            | 3        | 0        | 0        | 3        |
| 6.               | EG3101             | Technical English                                           | 3        | 1        | 0        | 4        |
| <b>PRACTICAL</b> |                    |                                                             |          |          |          |          |
| 7.               | CS3171             | Fundamentals of Computing and Python Programming Laboratory | 0        | 0        | 4        | 2        |
| 8.               | BS3171             | Physics and Chemistry Laboratory                            | 0        | 0        | 4        | 2        |
| <b>TOTAL</b>     |                    |                                                             | 15       | 2        | 8        | 21       |

**SEMESTER II**

| <b>Sl. No</b> | <b>Course Code</b> | <b>Course Title</b>                          | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|---------------|--------------------|----------------------------------------------|----------|----------|----------|----------|
| <b>THEORY</b> |                    |                                              |          |          |          |          |
| 1.            | EG3102             | Communicative English                        | 3        | 0        | 0        | 3        |
| 2.            | MA3102             | Engineering Mathematics – II                 | 3        | 1        | 0        | 4        |
| 3.            | BE3101             | Basic Electrical and Electronics Engineering | 3        | 0        | 0        | 3        |
| 4.            | BE3102             | Basic Civil and Mechanical Engineering       | 3        | 0        | 0        | 3        |
| 5.            | ME3101             | Engineering Graphics                         | 3        | 0        | 2        | 4        |
| 6.            | EG3102             | Communicative English                        | 3        | 0        | 0        | 3        |

| <b>PRACTICAL</b> |        |                                                         |           |          |          |           |
|------------------|--------|---------------------------------------------------------|-----------|----------|----------|-----------|
| 7.               | BE3171 | Basic Electrical and Electronics Engineering Laboratory | 0         | 0        | 2        | 1         |
| 8.               | BE3172 | Basic Civil and Mechanical Engineering Laboratory       | 0         | 0        | 2        | 1         |
| <b>TOTAL</b>     |        |                                                         | <b>15</b> | <b>1</b> | <b>6</b> | <b>19</b> |

### SEMESTER III

| <b>Sl. No</b>    | <b>Course Code</b> | <b>Course Title</b>                           | <b>L</b>  | <b>T</b> | <b>P</b>  | <b>C</b>  |
|------------------|--------------------|-----------------------------------------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>    |                    |                                               |           |          |           |           |
| 1.               | MA3201             | Engineering Mathematics-III                   | 3         | 1        | 0         | 4         |
| 2.               | ME3201             | Engineering Mechanics                         | 2         | 1        | 0         | 3         |
| 3.               | ME3203             | Engineering Thermodynamics                    | 3         | 0        | 0         | 3         |
| 4.               | ME3204             | Fluid Mechanics and Machinery                 | 3         | 0        | 0         | 3         |
| 5.               | ME3205             | Manufacturing Processes-I                     | 3         | 0        | 0         | 3         |
| 6.               | EE3203             | Electrical Engineering and Control            | 3         | 0        | 0         | 3         |
| <b>PRACTICAL</b> |                    |                                               |           |          |           |           |
| 7.               | ME3271             | CAD and Modelling Laboratory                  | 0         | 0        | 3         | 1         |
| 8.               | ME3272             | Fluid Mechanics and Machinery Laboratory      | 0         | 0        | 3         | 1         |
| 9.               | ME3273             | Manufacturing Processes Laboratory-I          | 0         | 0        | 3         | 1         |
| 10.              | EE3272             | Electrical Engineering and Control Laboratory | 0         | 0        | 3         | 1         |
| <b>TOTAL</b>     |                    |                                               | <b>17</b> | <b>2</b> | <b>12</b> | <b>23</b> |

### SEMESTER IV

| Sl. No           | Course Code | Course Title                          | L         | T        | P        | C         |
|------------------|-------------|---------------------------------------|-----------|----------|----------|-----------|
| <b>THEORY</b>    |             |                                       |           |          |          |           |
| 1.               | MA3207      | Probability and Statistics            | 2         | 1        | 0        | 3         |
| 2.               | BS3201      | Environmental Studies                 | 2         | 0        | 0        | 2         |
| 3.               | ME3206      | Kinematics of Machinery               | 3         | 1        | 0        | 4         |
| 4.               | ME3207      | Manufacturing Processes-II            | 3         | 0        | 0        | 3         |
| 5.               | ME3208      | Strength of Materials                 | 3         | 0        | 0        | 3         |
| 6.               | ME3209      | Thermal Engineering                   | 3         | 0        | 0        | 3         |
| <b>PRACTICAL</b> |             |                                       |           |          |          |           |
| 7.               | ME3275      | Manufacturing Processes Laboratory-II | 0         | 0        | 2        | 1         |
| 8.               | ME3276      | Strength of Materials Laboratory      | 0         | 0        | 2        | 1         |
| 9.               | ME3277      | Thermal Engineering Laboratory-I      | 0         | 0        | 2        | 1         |
| <b>TOTAL</b>     |             |                                       | <b>16</b> | <b>2</b> | <b>6</b> | <b>21</b> |

### SEMESTER V

| Sl. No        | Course Code | Course Title                         | L | T | P | C |
|---------------|-------------|--------------------------------------|---|---|---|---|
| <b>THEORY</b> |             |                                      |   |   |   |   |
| 1.            | MS3201      | Professional and Business Ethics     | 2 | 0 | 0 | 2 |
| 2.            | ME3202      | Engineering Materials and Metallurgy | 3 | 0 | 0 | 3 |
| 3.            | ME3211      | Dynamics of Machinery                | 3 | 1 | 0 | 4 |
| 4.            | ME3212      | Energy Conversion Technology         | 3 | 0 | 0 | 3 |
| 5.            | *****       | Core Elective-I                      | 3 | 0 | 0 | 3 |
| 6.            | *****       | Open Elective-I                      | 3 | 0 | 0 | 3 |

| <b>PRACTICAL</b> |        |                                  |           |          |          |           |
|------------------|--------|----------------------------------|-----------|----------|----------|-----------|
| 7.               | ME3279 | Dynamics of Machinery Laboratory | 0         | 0        | 2        | 1         |
| 8.               | ME3280 | CAD / CAM Laboratory             | 0         | 0        | 2        | 1         |
| 9.               | ME3281 | Metallurgy Laboratory            | 0         | 0        | 2        | 1         |
| <b>TOTAL</b>     |        |                                  | <b>17</b> | <b>1</b> | <b>6</b> | <b>21</b> |

### SEMESTER VI

| <b>Sl. No</b>    | <b>Course Code</b> | <b>Course Title</b>                            | <b>L</b>  | <b>T</b> | <b>P</b> | <b>C</b>  |
|------------------|--------------------|------------------------------------------------|-----------|----------|----------|-----------|
| <b>THEORY</b>    |                    |                                                |           |          |          |           |
| 1.               | AI32D1             | Fundamentals of Artificial Intelligence        | 3         | 0        | 0        | 3         |
| 2.               | ME3213             | Mechanical Measurements & Metrology            | 3         | 0        | 0        | 3         |
| 3.               | ME3214             | Heat and Mass Transfer                         | 3         | 1        | 0        | 4         |
| 4.               | ME3215             | Design of Machine Elements                     | 3         | 1        | 0        | 4         |
| 5.               | *****              | Core Elective - II                             | 3         | 0        | 0        | 3         |
| 6.               | *****              | Core Elective - III                            | 3         | 0        | 0        | 3         |
| <b>PRACTICAL</b> |                    |                                                |           |          |          |           |
| 7.               | ME3282             | Thermal Engineering Laboratory - II            | 0         | 0        | 2        | 1         |
| 8.               | ME3283             | Mechanical Measurements & Metrology Laboratory | 0         | 0        | 2        | 1         |
| 9.               | ME32P1             | Summer Internship                              | 0         | 0        | 2        | 1         |
| <b>TOTAL</b>     |                    |                                                | <b>18</b> | <b>2</b> | <b>6</b> | <b>23</b> |

### SEMESTER VII

| Sl. No           | Course Code | Course Title                   | L         | T        | P        | C         |
|------------------|-------------|--------------------------------|-----------|----------|----------|-----------|
| <b>THEORY</b>    |             |                                |           |          |          |           |
| 1.               | MS3202      | Principles of Management       | 3         | 0        | 0        | 2         |
| 2.               | ME3216      | Design of Transmission System  | 2         | 1        | 0        | 3         |
| 3.               | *****       | Core Elective-IV               | 3         | 0        | 0        | 3         |
| 4.               | *****       | Core Elective-V                | 3         | 0        | 0        | 3         |
| 5.               | *****       | Core Elective-VI               | 3         | 0        | 0        | 3         |
| 6.               | *****       | Open Elective-III              | 3         | 0        | 0        | 3         |
| <b>PRACTICAL</b> |             |                                |           |          |          |           |
| 7.               | ME3284      | Simulation Laboratory          | 0         | 0        | 2        | 1         |
| 8.               | ME3285      | Mechatronics Laboratory        | 0         | 0        | 2        | 1         |
| 9.               | ME32P2      | Design and Fabrication Project | -         | -        | 2        | 1         |
| <b>TOTAL</b>     |             |                                | <b>17</b> | <b>1</b> | <b>6</b> | <b>20</b> |

### SEMESTER VIII

| Sl. No           | Course Code | Course Title      | L        | T        | P         | C         |
|------------------|-------------|-------------------|----------|----------|-----------|-----------|
| <b>THEORY</b>    |             |                   |          |          |           |           |
| 1.               | *****       | Core Elective-VII | 3        | 0        | 0         | 3         |
| 2.               | *****       | Open Elective-IV  | 3        | 0        | 0         | 3         |
| <b>PRACTICAL</b> |             |                   |          |          |           |           |
| 7.               | ME32P5      | Project Work      | 0        | 0        | 16        | 8         |
| <b>TOTAL</b>     |             |                   | <b>6</b> | <b>0</b> | <b>16</b> | <b>14</b> |

### Elective List

| Sl. No        | Course Code | Course Title                            | L | T | P | C |
|---------------|-------------|-----------------------------------------|---|---|---|---|
| <b>THEORY</b> |             |                                         |   |   |   |   |
| 1.            | ME32A1      | Artificial Intelligence and Robotics    | 3 | 0 | 0 | 3 |
| 2.            | ME32A2      | Industrial Robotics                     | 3 | 0 | 0 | 3 |
| 3.            | ME32A3      | Turbo Machinery                         | 3 | 0 | 0 | 3 |
| 4.            | ME32A4      | Welding Technology                      | 3 | 0 | 0 | 3 |
| 5.            | ME32A5      | Applied Hydraulics and Pneumatics       | 3 | 0 | 0 | 3 |
| 6.            | ME32A6      | Integrated Design& Manufacturing        | 3 | 0 | 0 | 3 |
| 7.            | ME32A7      | Non-Destructive Evaluation &Testing     | 3 | 0 | 0 | 3 |
| 8.            | ME32A8      | Mechanics of Composite Materials        | 3 | 0 | 0 | 3 |
| 9.            | ME32A9      | Machine Tool Technology                 | 3 | 0 | 0 | 3 |
| 10.           | ME32B1      | Nuclear Power Engineering               | 3 | 0 | 0 | 3 |
| 11.           | ME32B2      | Theory of Combustion And Emission       | 3 | 0 | 0 | 3 |
| 12.           | ME32B3      | Advanced Fluid Mechanics                | 3 | 0 | 0 | 3 |
| 13.           | ME32B4      | Advanced Engineering Thermodynamics     | 3 | 0 | 0 | 3 |
| 14.           | ME32B5      | Computational Fluid Dynamics            | 3 | 0 | 0 | 3 |
| 15.           | ME32B6      | Technology of Surface Coating           | 3 | 0 | 0 | 3 |
| 16.           | ME32B7      | Refrigeration and Air-Conditioning      | 3 | 0 | 0 | 3 |
| 17.           | ME32B8      | Lean Manufacturing                      | 3 | 0 | 0 | 3 |
| 18.           | ME32B9      | Design of Jigs, Fixtures and Press Tool | 3 | 0 | 0 | 3 |

### Open Elective List

| Sl. No        | Course Code | Course Title                          | L | T | P | C |
|---------------|-------------|---------------------------------------|---|---|---|---|
| <b>THEORY</b> |             |                                       |   |   |   |   |
| 1.            | ME32D1      | Supply Chain Management               | 3 | 0 | 0 | 3 |
| 2.            | ME32D2      | Industrial Engineering and Psychology | 3 | 0 | 0 | 3 |
| 3.            | ME32D3      | Mechanical Handling                   | 3 | 0 | 0 | 3 |
| 4.            | ME32D4      | Advanced Computer Graphics and Solid  | 3 | 0 | 0 | 3 |
| 5.            | ME32D5      | Quality Assurance and Reliability     | 3 | 0 | 0 | 3 |

## SEMESTER I

| Sl. No           | Course Code | Course Title                                                | L         | T        | P        | C         |
|------------------|-------------|-------------------------------------------------------------|-----------|----------|----------|-----------|
| <b>THEORY</b>    |             |                                                             |           |          |          |           |
| 1.               | EG3101      | Technical English                                           | 3         | 1        | 0        | 4         |
| 2.               | MA3101      | Engineering Mathematics – I                                 | 3         | 1        | 0        | 4         |
| 3.               | BS3101      | Engineering Physics                                         | 3         | 0        | 0        | 3         |
| 4.               | BS3102      | Engineering Chemistry                                       | 3         | 0        | 0        | 3         |
| 5.               | CS3101      | Fundamentals of Computing and Python Programming            | 3         | 0        | 0        | 3         |
| 6.               | EG3101      | Technical English                                           | 3         | 1        | 0        | 4         |
| <b>PRACTICAL</b> |             |                                                             |           |          |          |           |
| 7.               | CS3171      | Fundamentals of Computing and Python Programming Laboratory | 0         | 0        | 4        | 2         |
| 8.               | BS3171      | Physics and Chemistry Laboratory                            | 0         | 0        | 4        | 2         |
| <b>TOTAL</b>     |             |                                                             | <b>15</b> | <b>2</b> | <b>8</b> | <b>21</b> |

|               |                          |          |          |          |          |
|---------------|--------------------------|----------|----------|----------|----------|
| <b>EG3101</b> | <b>Technical English</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                          | <b>3</b> | <b>1</b> | <b>0</b> | <b>4</b> |

### AIM:

To impart the fundamental knowledge of Technical English to the students in order to achieve a well-founded knowledge about the Fundamentals of English.

### OBJECTIVES

1. To develop the linguistic, communicative and critical thinking competencies of First Year Engineering students
2. To enhance the understanding of the complex grammatical structures of the English language to students
3. To improve the language proficiency of students in English with emphasis on Vocabulary, Grammar, Listening, Speaking, Reading, and Writing skills
4. To introduce the students to the basic phonetics of English and make them grasp the various sounds of the English language to improve their pronunciation

| Course Outcomes |                                                                                                                                                                                | Cognitive Skill |
|-----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01           | The students will be able to improve their vocabulary relating to Engineering and Technology, and use articles and prepositions effectively in sentences.                      | R               |
| CO-02           | The students will be able to learn grammatical items like tense, voice, compound nouns etc. and thereby enhance their linguistic competence.                                   | U               |
| CO-03           | The students will be able to learn definitions of technical terms, relative pronouns etc. which will develop their language competence.                                        | A               |
| CO-04           | The students will be able to acquire the essentials of writing skills relating to CV, Resume, Formal and Business Letters.                                                     | U               |
| CO-05           | The students will be able to learn English phonemes such as Vowels, Diphthongs and Consonants which will be instrumental in improving their pronunciation and speaking skills. | R               |

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

#### Mapping of Course Outcomes with Programme Outcomes

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-K | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | M    | S    | S    | M    | S    | S    | S    | M    | S    | S    |
| CO-02    | M    | S    | M    | M    | S    | S    | M    | S    | S    | S    | M    | S    |
| CO-03    | S    | M    | M    | S    | M    | M    | S    | M    | M    | M    | S    | M    |
| CO-04    | M    | S    | M    | M    | S    | M    | S    | M    | S    | M    | S    | M    |
| CO-05    | S    | M    | S    | S    | M    | S    | M    | S    | M    | S    | M    | S    |

S-Strong, M-Medium, L-Low, N-Not relevant

#### Unit I:

9

Word formation with prefixes and suffixes – Articles – Conjunctions – Prepositions – Expansion of Abbreviations and Acronyms – Writing Checklists – Writing Instructions.

#### Unit II:

9

Tense – Voice – Punctuation – Expansion of Compound Nouns – Writing Recommendations – Paragraph Writing – Types, Structures and Features of a Paragraph – Creating Coherence—Organizing Principles of Paragraphs in Documents.

**Unit III:** **9**  
 Discourse Markers – Gerunds and Present Participles – Relative Pronouns – Conditional Clauses –  
 Definitions of Technical Terms – Transcoding : Bar Chart - Flow Chart - Pie Chart - Tree Diagram  
 - Tabular Column.

**Unit IV:** **9**  
 Concord – Clauses – Phrases – Numerical Adjectives – CV/Resume Writing – Virtual  
 Communication: E-Mail Writing – Essay Writing : Basic Format of an Essay - Types – Examples.

**Unit V:** **9**  
 Basic Phonetics : Phonemes – Vowels, Diphthongs and Consonants – Classification : Pure  
 Vowels/Monophthongs – Vowel Glides /Diphthongs.

**L: 45 + T:15 = TOTAL: 60 HOURS**

**EXTENSIVE READING:**

Shiv Khera, *You Can Win*, Milan, Delhi, 2004

**NOTE:**

The book given under Extensive Reading is meant for inculcating the reading habit of the students. They need not be used for testing purposes.

**TEXT BOOK**

1. Khaleel Rahuman A., Deepa P., Sheila J., Mathi Vathani J. , *Technical English*, R. K. Publishers, 2023.

**REFERENCES:**

1. Nagarajan S., Senthil C. S., *Engineering English I & II*, Sri Krishna Publications, 2004.
2. Jewelcy Jawahar , Rathna P., *English Work Book for First Year B.E./ B.Tech.*, VRB Publishers, Chennai, 2008.

| MA3101 | ENGINEERING MATHEMATICS - I | L | T | P | C |
|--------|-----------------------------|---|---|---|---|
|        |                             | 3 | 1 | 0 | 4 |

**AIM:**

To impart the fundamental knowledge of Engineering Mathematics to the students in order to achieve a well-founded knowledge about the principles of Mathematics

**OBJECTIVE:**

The course objective is to develop the required skill of the students in the area of Engineering Mathematics with special mphasis on the characteristic equation of matrices, differential calculus, Beta and Gamma functions and to develop basic knowledge to the students in double and triple integration.

| Course Outcome - COs |                                                                                                                                                                                                                                                                        | Cognitive Skill |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Understand the characteristic equation and find eigen values and Eigen vector of a real matrix. Compute the eigen value and eigen vector using properties. Verify Cayley Hamilton theorem and its applications. Apply orthogonal transformation of a symmetric matrix. | U, A ,E. R      |
| CO-02                | Define the definitions and formula for curvature, radius of curvature, circle of curvature. Apply the formula and solve problems using the required formulas also find the evolute of the curves.                                                                      | U, A ,E, An     |
| CO-03                | Know about the differentiation formulae and apply on partial derivatives, total derivatives and Jacobians. Verify the functions be maximum or minimum and Lagrange's multiplier method. Express the Taylor's expansion for two variables.                              | U, A ,E. R      |
| CO-04                | Know the Fundamental concepts of improper integrals, Beta and gamma function and their properties. Develop the skill in the relation between Beta and Gamma Functions. Calculate definite integral values using Beta and Gamma Functions.                              | U, A , An,E     |
| CO-05                | Evaluate the double and multiple integrals and can apply these concepts to find areas of regions on a plane or in space. Graph Cartesian and polar equations. Convert Cartesian coordinates into polar coordinates.                                                    | U, A , An,E     |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | S    | M    | S    | S    | S    | S    | M    | S    | S    | M    |
| CO-02    | S    | M    | M    | M    | S    | S    | M    | S    | M    | M    | M    | M    |
| CO-03    | S    | M    | M    | M    | S    | S    | M    | M    | M    | S    | S    | M    |
| CO-04    | S    | M    | S    | M    | S    | M    | S    | S    | M    | S    | S    | M    |
| CO-05    | S    | M    | S    | M    | S    | M    | S    | S    | M    | S    | S    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### UNIT-I MATRICES

9

Characteristic equation - Eigen values and Eigen vectors of a real matrix - Properties of eigen values and eigen vectors(without proof)- Cayley Hamilton theorem (statement only), verification and its applications - Orthogonal and Symmetric matrices and their properties(excluding proof)- Orthogonal transformation of a symmetric matrix to diagonal form.

#### UNIT-II DIFFERENTIAL CALCULUS

9

Curvature - Cartesian co-ordinates and parametric form -Centre and radius of curvature, Circle of curvature - Evolutes.

**UNIT-III FUNCTIONS OF SEVERAL VARIABLES****9**

Partial derivatives - Total derivatives - Jacobians - Properties - Maxima and minima for functions of two variables - Lagrange Multiplier method- Taylor's expansion.

**UNIT-IV IMPROPER INTEGRALS****9**

Evaluation of improper integrals- Beta and Gamma functions - Properties - Relation between Beta and Gamma functions - Evaluation of integrals using Beta and Gamma functions.

**UNIT-V MULTIPLE INTEGRALS****9**

Evaluation of double and triple integrals - Area enclosed by plane curves as double integral in cartesian and polar co-ordinates - Change of order of integration- Transformation of Cartesian coordinates into polar coordinates.

**L: 45 + T: 15, TOTAL: 60 HOURS****OUTCOMES:**

At the end of the course, the students will be familiar with various concepts of calculus which are essential for engineering. They also become acquainted with the basic ideas of multiple integrals and their usage.

**TEXT BOOKS:**

1. Grewal B.S., "Higher Engineering Mathematics" - 40<sup>th</sup> Edition , Khanna Pub- lishers, Delhi 2007

**REFERENCES:**

1. M.Immaculate Mary , K.Uma Samundesvari," Engineering Mathematics - I" Revised Edition, R.K Publishers, 2016.
2. Veerarajan T, " Engineering Mathematics (for first year)", Fourth Edition, Tata McGraw- Hill Publishing Company Ltd., New Delhi , 2007.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", Seventh Edition, Wi- ley India, 2007.
4. P.Kandasamy , K.Thilagavathy , K.Gunavathy" Engineering Mathematics" Vol,1 ,S.Chand & Company Ltd.2002.
5. B.V. Ramana,"Higher Engineering Mathematics" Second Edition Tata McGraw- Hill, Publishing Company Ltd., New Delhi, 2006 .

| BS3101 | ENGINEERING PHYSICS | L | T | P | C |
|--------|---------------------|---|---|---|---|
|        |                     | 3 | 0 | 0 | 3 |

**AIM:**

To have a thorough knowledge of the basics of Physics particularly engineering topics to engineering students.

**OBJECTIVES**

The course objective is to provide basic ideas about the principles of physics related to properties of matter, wave optics, heat, quantum concepts and materials engineering problems.

| Course Outcome–Cos |                                                                                                                                                                 | Cognitive Skill |
|--------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01              | Students will be able to understand and apply knowledge about the properties of materials.                                                                      | R,U,A           |
| CO-02              | Students will be able to understand the types of oscillations and the wave nature of light in interference, diffraction and polarization phenomenon.            | R,U,A,E         |
| CO-03              | Students will be able to state and explain the various laws of thermodynamics, understand entropy and its application.                                          | R,U,A,An,<br>,E |
| CO-04              | Students gain basic knowledge about quantum mechanics and will be able to solve time dependent and time independent Schrodinger equation for simple potentials. | R,U,A,E,S       |
| CO-05              | Students will be able to know the different types of crystal structures and also gain basic knowledge about nanomaterials and biomaterials.                     | R,U,A,E         |

R-Remember,U-Understand,A-Apply,An-Analyze,E-Evaluate,S-Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | S    | S    | S    | S    | S    | S    | S    | S    | S    | S    |
| CO-02    | S    | S    | S    | M    | S    | S    | S    | M    | S    | S    | S    | M    |
| CO-03    | S    | S    | S    | S    | S    | S    | S    | S    | S    | S    | S    | S    |
| CO-04    | S    | M    | S    | S    | S    | M    | S    | S    | S    | M    | S    | S    |
| CO-05    | S    | S    | M    | M    | S    | S    | M    | M    | S    | S    | M    | M    |

S-Strong, M-Medium, L-Low, N-Not Relevant

#### Unit I: Properties of Matter

9

Elasticity – Poisson’s ratio – Stress-strain diagram – factors affecting elasticity – bending of beams – cantilever depression – Young’s Modulus- theory and experiment of Young’s modulus determination (uniform and non-uniform bending) –Shear Modulus – twisting couple – hollow cylinder – torsion pendulum – determination of rigidity modulus - Bulk Modulus - applications of elastic behaviours of materials.

#### Unit II: Oscillations and Wave optics

9

Oscillations - Rectilinear motion - Oscillations or Vibrations - Simple Harmonic Motion - Damped Harmonic motion - Real oscillatory system - Forced or Driven oscillation. Wave optics - Interference of light – Photons - Young's Double Slit Experiment - Huygens's Principle - Diffraction - Diffraction Grating - Polarization.

**Unit III: Thermal Physics****9**

Transfer of heat energy (conduction, convection and radiation) - thermal expansion of solids and liquids – expansion joints – bimetallic strips-Thermal conductivity- Forbe's and Lee's disc methods (theory and experiment)- thermal insulation in buildings -Laws of thermodynamics- heat exchanger -solar power- applications of solar power (solar water heater, photo voltaic cell).

**Unit IV: Quantum Physics****9**

Matter waves- de-Broglie wavelength - Schrodinger's wave equation-time independent and time dependent equations- physical significance of wave function- uncertainty principle and its application- energy and momentum operators-particle in a one dimensional box- scanning electron microscope- transmission electron microscope-scanning tunnelling microscope.

**Unit V:Material Physics****9**

Single crystalline, polycrystalline and amorphous materials- Single crystals: unit cell, crystal systems, Bravais lattices, directions and planes in a crystal, miller indices – inter planar distances. Introduction and applications of Metallic glasses, Shape Memory Alloys (SMA), Nanomaterials, Biomaterials.

**TOTAL: 45 HOURS****TEXT BOOKS**

1. Engineering Physics I by Bindhu B, Sagi Rani C, Meenadevi V N, Ganapathi Raman R, RK Publishers 2015.
2. Engineering Physics II by Bindhu B, Geetha Kumari R, Sugirtha Suni N Y, RK Publishers 2016.
3. Engineering Physics by R K Gaur And S L Gupta, Dhanpat Rai Publications 2011.
4. A Text Book Oscillations, Waves & Acoustics by Dr. M. Gosh, Dr. D. Battacharya, S. Chand, Revised Edition.

**REFERENCES:**

3. Engineering Physics by Rajendran V, McGraw-Hill, New Delhi, 2013
4. Engineering Physics by Arumugam M, Anuradha Publications, 2014.
5. Principles of Physics by Halliday D, Resnick R and Walker J, Wiley 2015.
6. Physics for scientist and Engineers by Serway R A and Jewett J W, Cengage Learning 2010.
7. Engineering Physics by Bhattacharya D K and Poonam T, Oxford University Press 2015.
8. Engineering Physics by Pandey B K and Chaturvedi, Cengage Learning India 201

| BS3102 | ENGINEERING CHEMISTRY | L | T | P | C |
|--------|-----------------------|---|---|---|---|
|        |                       | 3 | 0 | 0 | 3 |

**AIM:**

To have a thorough knowledge of the basics of chemistry particularly engineering topics to engineering students.

**OBJECTIVES:**

To make the students conversant with the principles of the following topics:(i) Use of free energy in chemical equilibria (ii) Water chemistry (iii) Periodic properties (iv) Spectroscopic techniques and applications and (v) Organic reactions and synthesis of a drug molecule.

| Course Outcome - COs |                                                                                                              | Cognitive Skill |
|----------------------|--------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Students will understand the basic concept of Estimations of entropy and free energies. Free energy and emf. | U               |
| CO-02                | Students will study disinfection by chlorination, ozone and UV treatments.                                   | R               |
| CO-03                | Students will know the Effective nuclear charge, penetration of orbitals, variations of s, p, d              | U               |
| CO-04                | Principles of spectroscopy and selection rules. Electronic spectroscopy.                                     | A               |
| CO-05                | Student will study Introduction to reactions involving substitution, addition, elimination,                  | An              |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-K | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | L    | S    | L    | M    | M    | L    | M    | S    | S    | S    | L    |
| CO-02    | S    | L    | S    | L    | M    | M    | L    | M    | S    | S    | S    | L    |
| CO-03    | S    | M    | S    | M    | S    | M    | L    | S    | S    | S    | S    | L    |
| CO-04    | S    | M    | S    | L    | S    | M    | L    | M    | S    | S    | S    | L    |
| CO-05    | S    | M    | S    | L    | M    | M    | L    | M    | S    | S    | S    | L    |

S- Strong, M- Medium, L-Low, N- Not Relevant

### UNIT I: USE OF FREE ENERGY IN CHEMICAL EQUILIBRIA

9

Thermodynamic functions: energy, entropy and free energy - Estimations of entropy and free energies - Free energy and emf. Cell potentials, the Nernst equation and applications - Acid base, oxidation reduction and solubility equilibria. Corrosion - Use of free energy considerations in metallurgy through Ellingham diagrams.

### UNIT II: WATER CHEMISTRY

9

Water as a universal solvent – hard and soft water – reasons for hardness – disadvantages of hard water in washing and industrial purposes - estimation of hardness by EDTA method, problems; boiler feed water – characteristics- softening methods - external conditioning – demineralization (ion exchange) process, desalination by reverse osmosis method- internal conditioning (phosphate, calgon and carbonate conditioning methods); stages in domestic water treatment – disinfection by chlorination, ozone and UV treatments.

### UNIT III: PERIODIC PROPERTIES

9

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron

affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.

#### **UNIT IV: SPECTROSCOPIC TECHNIQUES AND APPLICATIONS 9**

Principles of spectroscopy and selection rules - Electronic spectroscopy - Fluorescence and its applications in medicine - Vibrational and rotational spectroscopy of diatomic molecules – Applications - Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques - Diffraction and scattering.

#### **UNIT V: ORGANIC REACTIONS AND SYNTHESIS OF A DRUG MOLECULE 9**

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings - Synthesis of a commonly used drug molecule.

**TOTAL: 45 HOURS**

#### **Suggested Text Books**

1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistry, by P. W. Atkins
6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition.

|               |                                                             |          |          |          |          |
|---------------|-------------------------------------------------------------|----------|----------|----------|----------|
| <b>CS3101</b> | <b>FUNDAMENTALS OF COMPUTING AND PYTHON<br/>PROGRAMMING</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                                             | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

#### **AIM:**

To explore the basics of algorithmic problem solving and to understand python programming.

#### **OBJECTIVES**

- To know the basics of algorithmic problem solving
- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and call them.
- To use Python data structures — lists, tuples, dictionaries.
- To do input/output with files in Python.

| Course Outcome - COs |                                                                                                                                            | Cognitive Skill |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | To understand Algorithms, building blocks of algorithms (statements, state, control flow, functions),                                      | U,R             |
| CO-02                | To understand Python interpreter and interactive mode; values and types: integer, float, boolean, string, and list; variables, expressions | U,R             |
| CO-03                | To understand Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional                     | U,R             |
| CO-04                | To understand Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters;          | U,R             |
| CO-05                | Files and exception: text files, reading and writing files, format operator; command line argument                                         |                 |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-K | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | M    | M    | M    | S    | S    | M    | S    | S    | S    | M    |
| CO-02    | S    | S    | M    | M    | M    | S    | S    | M    | S    | S    | S    | M    |
| CO-03    | S    | S    | M    | M    | M    | S    | S    | M    | S    | S    | S    | M    |
| CO-04    | S    | S    | M    | M    | M    | S    | S    | M    | S    | S    | S    | M    |
| CO-05    | S    | S    | M    | M    | M    | S    | S    | M    | S    | S    | S    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

### UNIT I: ALGORITHMIC PROBLEM SOLVING

9

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

### UNIT II: DATA, EXPRESSIONS, STATEMENTS

9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

### UNIT III: CONTROLFLOW, FUNCTIONS

9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions:

return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

#### **UNIT IV: LISTS,TUPLES, DICTIONARIES**

**9**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

#### **UNIT V: FILES,MODULES, PACKAGES**

**9**

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

**TOTAL: 45 HOURS**

#### **TEXT BOOKS:**

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist``, 2nd edition, Updated for Python 3, Shroff /O'Reilly Publishers, 2016  
(<http://greenteapress.com/wp/thinkpython/>)
2. Guido van Rossum and Fred L. Drake Jr, —An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd.,2011.

#### **REFERENCES:**

1. John V Guttag, —Introduction to Computation and Programming Using Python``, Revisedand Revised and expanded Edition, MIT Press ,2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd.,2016.
3. Timothy A. Budd, —Exploring Python®, Mc-Graw Hill Education (India) Private Ltd.,,2015.
4. KennethA.Lambert,—Fundamentals ofPython:FirstPrograms®,CENGAGE Learning,2012.  
Charles Dierbach, —Introduction to Computer Science using Python: A Computational ProblemSolving Focus, Wiley India Edition,2013.
5. Paul Gries, Jennifer Campbell and Jason Montojo, —Practical Programming: An Introduction to Computer Science using Python 3®, Second edition, Pragmatic Programmers, LLC,2013.

| BS3171 | PHYSICS & CHEMISTRY LABORATORY | L | T | P | C |
|--------|--------------------------------|---|---|---|---|
|        |                                | 0 | 0 | 4 | 2 |

#### **Aim**

The objective of the course is to develop the interest among the students regarding physics & chemistry and their applications in engineering.

#### **Objective :**

The course objective is to teach students, the importance of physics through involvement in experiments and to have knowledge of the world due to constant interplay between observations and hypothesis.

### PHYSICS LAB

| Course Outcome – Cos |                                                                                                                                                | Cognitive Skill |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | The students will be able to analyse the physical principle involved in various instruments and also relate the principle to new applications. | R,U,A,An,E      |
| CO-02                | Various experiments in the areas of optics, properties of matter and ultrasonics will nurture the students in all branches of engineering.     | R,U,A,An,E      |
| CO-03                | The students will be able to think innovatively and also improve the creative skills that are essential for engineering.                       | R,U,A,An,E      |
| CO-04                | The students will be able to gain knowledge of new concept in the solution of practical oriented problems and theoretical problems.            | R,U,A,An,E      |
| CO-05                | The students will be able to understand measurement technology ,usage of new instruments and real time applications in engineering studies.    | R,U,A,An,E      |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | S    | S    | S    | S    | S    | S    | S    | S    | S    | S    |
| CO-02    | S    | S    | S    | M    | S    | S    | S    | M    | S    | S    | S    | M    |
| CO-03    | S    | S    | S    | S    | S    | S    | S    | S    | S    | S    | S    | S    |
| CO-04    | S    | M    | S    | S    | S    | M    | S    | S    | S    | M    | S    | S    |
| CO-05    | S    | S    | M    | M    | S    | S    | M    | M    | S    | S    | M    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### List of experiments: Physics Laboratory (Any Five Experiments)

1. Determination of velocity of ultrasonic waves and compressibility of the given liquid by Ultrasonic interferometer.(Real and Virtual Lab)
2. Determination of rigidity modulus by Torsional pendulum. (Real and Virtual Lab)
3. Determination of coefficient of viscosity by Poiseulli's method.
4. Determination of Youngs modulus by non-uniform bending method.(Real and Virtual Lab)
5. Determination of LASER parameters using LASER diode. (Real and Virtual Lab)
6. Determination of band gap of the semi-conductor.(Real and Virtual Lab)
7. Determination of wavelength of mercury spectrum by diffraction grating.(Real and virtual lab)
8. Determination of wavelength of light by Newton's rings.(Real and Virtual Lab)
9. Determination of angle of the prism using spectrometer. (Real and Virtual Lab)

### CHEMISTRY LAB (Any Five experiments)

#### Aim

The objective of the course is to develop the interest among the students regarding chemistry and their applications in engineering.

**Objective :**

The course objective is to teach students, the importance of chemistry through involvement in experiments and to have knowledge of the world due to constant interplay between observations and hypothesis.

| Course Outcome – Cos |                                                                                                                          | Cognitive Skill |
|----------------------|--------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | learn and apply basic techniques used in chemistry laboratory for small/large scale water analyses/purification.         | R,U,A,An, E     |
| CO-02                | be able estimate the ions/metal ions present in domestic/industry waste water.                                           | R ,U,A, An,E    |
| CO-03                | utilize the fundamental laboratory techniques for analyses such as titrations, separation/purification and spectroscopy. | R,U,A,An, E     |
| CO-04                | able to analyze and gain experimental skill.                                                                             | R,U,A,An, E     |
| CO-05                | The students will be able to understand real time applications in engineering studies.                                   | R,U,A,An, E     |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | S    | S    | S    | M    | N    | M    | L    | L    | S    | S    |
| CO-02    | S    | S    | S    | S    | S    | M    | N    | M    | L    | L    | S    | S    |
| CO-03    | S    | S    | S    | S    | S    | M    | N    | M    | L    | L    | S    | S    |
| CO-04    | S    | S    | S    | M    | N    | N    | M    | L    | L    | L    | S    | S    |
| CO-05    | S    | S    | S    | S    | S    | M    | N    | M    | L    | L    | S    | S    |

**List of Experiments**

1. Determination of conductance of solutions
2. Potentiometry - determination of redox potentials and emfs
3. Synthesis of drug
4. Determination of Chloride content
5. Determination of hardness of water sample
6. Determination of Alkalinity of water sample
7. Virtual lab experiments

|        |                                                         |   |   |   |   |
|--------|---------------------------------------------------------|---|---|---|---|
| CS3171 | FUNDAMENTALS OF COMPUTING AND PYTHON<br>PROGRAMMING LAB | L | T | P | C |
|        |                                                         | 0 | 0 | 4 | 2 |

**AIM:**

To explore the basics of algorithmic problem solving and to understand python programming.

**OBJECTIVES:**

- ✓ To write, test, and debug simple Python programs.
- ✓ To implement Python programs with conditionals and loops.
- ✓ Use functions for structuring Python programs.
- ✓ Represent compound data using Python lists, tuples, dictionaries.
- ✓ Read and write data from/to files in Python.

| Course Outcome - COs |                                                                     | Cognitive Skill |
|----------------------|---------------------------------------------------------------------|-----------------|
| CO-01                | To study the Programs that take command line arguments (word count) | U, An           |
| CO-02                | To study the most frequent words in a text read from a file         | U, An           |
| CO-03                | To study the Simulate elliptical orbits in Pygame                   | U, An           |
| CO-04                | To study the Simulate bouncing ball using Pygame                    | U, An           |
| CO-05                | To study the square root of a number (Newton's method)              | U, An           |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

**Mapping of Course Outcome with Programme Outcome**

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-K | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | M    | L    | L    | M    | S    | M    | S    | S    | S    | L    |
| CO-02    | S    | S    | S    | M    | L    | M    | S    | M    | S    | S    | S    | L    |
| CO-03    | S    | S    | S    | L    | L    | M    | S    | M    | S    | S    | S    | L    |
| CO-04    | S    | S    | S    | L    | L    | M    | S    | M    | S    | S    | S    | L    |
| CO-05    | S    | S    | S    | L    | L    | M    | S    | M    | S    | S    | S    | L    |

S- Strong, M- Medium, L-Low, N- Not Relevant

**LIST OF PROGRAMS:**

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton's method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers

5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

**PLATFORM NEEDED:** Python 3 interpreter for Windows/Linux

**TOTAL: 45 HOURS**

## SEMESTER – II

| SL. NO            | COURSE CODE | COURSE TITLE                                            | L         | T        | P        | C         |
|-------------------|-------------|---------------------------------------------------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |                                                         |           |          |          |           |
| 1.                | EG3102      | Communicative English                                   | 3         | 0        | 0        | 3         |
| 2.                | MA3102      | Engineering Mathematics – II                            | 3         | 1        | 0        | 4         |
| 3.                | BE3101      | Basic Electrical and Electronics Engineering            | 3         | 0        | 0        | 3         |
| 4.                | BE3102      | Basic Civil and Mechanical Engineering                  | 3         | 0        | 0        | 3         |
| 5.                | ME3101      | Engineering Graphics                                    | 3         | 0        | 2        | 4         |
| <b>PRACTICALS</b> |             |                                                         |           |          |          |           |
| 6.                | BE3171      | Basic Electrical and Electronics Engineering Laboratory | 0         | 0        | 2        | 1         |
| 7.                | BE3172      | Basic Civil and Mechanical Engineering Laboratory       | 0         | 0        | 2        | 1         |
| <b>TOTAL</b>      |             |                                                         | <b>15</b> | <b>1</b> | <b>6</b> | <b>19</b> |

| EG3102 | COMMUNICATIVE ENGLISH | L | T | P | C |
|--------|-----------------------|---|---|---|---|
|        |                       | 3 | 0 | 0 | 3 |

### AIM:

To impart the fundamental knowledge of Technical English to the students in order to achieve a well-founded knowledge about the Fundamentals of English.

### Objective:

- To widen and expand students' knowledge of English vocabulary
- To develop skills of students in the areas of vocabulary, grammar, listening, speaking, reading, and writing
- To develop the knowledge, skills and strategies the student must possess to become proficient readers
- To make the students learn the importance and purpose of communication skills and overcome the communication barriers by gaining confidence
- To make the students understand how to apply technical information and knowledge in practical documents

| Course Outcome - COs |                                                                                                                                                   | Cognitive Skill |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Acquire the basic knowledge of Odd Words Out – Changing words from one form to another – Common Errors in English                                 | R,U             |
| CO-02                | Reading Comprehension – Skimming – Scanning – Predicting the Content                                                                              | R,U,A           |
| CO-03                | Students will understand the Introducing Oneself – Exchanging Personal Information – Small Talk : Family, Friends, Studies, Profession – Speaking | R,U,A           |
| CO-04                | Classify different plastic molding processes, Extrusion of Plastic and Thermoforming.                                                             | R,U,A           |
| CO-05                | The Theory of Communication – Definition and Scope – Nature, Importance.                                                                          | A               |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-K | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | M    | L    | L    | S    | M    | S    | M    | S    | S    | S    |
| CO-02    | M    | S    | M    | M    | L    | S    | M    | M    | S    | S    | S    | S    |
| CO-03    | M    | M    | L    | S    | L    | S    | S    | M    | M    | M    | S    | S    |
| CO-04    | M    | S    | L    | M    | L    | S    | M    | S    | S    | M    | S    | L    |
| CO-05    | M    | S    | L    | M    | L    | S    | S    | S    | M    | S    | S    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### UNIT I : VOCABULARY AND GRAMMAR

9

Parts of Speech – Sentence Structures – Technical Vocabulary – Synonyms – Antonyms – Homonyms – Homophones – Misspelled Words – One word Substitutes – Odd Words Out – Changing words from one form to another – Common Errors in English – Correction of Errors in Sentences.

#### UNIT II : LISTENING and READING

9

Reading Comprehension – Skimming – Scanning – Predicting the Content – Comprehension Questions – Inductive Reading – Close Reading – Note Making – Précis Writing.

#### UNIT III : SPEAKING

9

Introducing Oneself – Exchanging Personal Information – Small Talk : Family, Friends, Studies, Profession – Speaking : Greeting , Taking Leave – Product Description – Completing information – Gap Exercises – Presentation / Public Speaking Skills – Group Discussion – Debate – Role Play.

#### UNIT IV: TECHNICAL WRITING

9

Report Writing – Characteristics of a Report – Categories of Reports – Letter Writing (Formal Letters) : Job Application Letter with Resume – Letter Seeking Permission – Letter of Invitation – Letter Declining an Invitation – Letter of Complaint – Letter of Requisition.

#### UNIT V: TECHNICAL COMMUNICATION

9

The Theory of Communication – Definition and Scope – Nature, Importance and Types – Different Communication Models – Barriers to Communication – Effective Communication (Verbal / Non-verbal).

**TOTAL: 45 HOURS**

#### EXTENSIVE READING :

Can Field Jack, *Chicken Soup for the Soul*, Westland, Chennai, 1999.

#### NOTE:

The book given under Extensive Reading is meant for inculcating the reading habit of the students. They need not be used for testing purposes.

#### REFERENCE BOOKS:

1. Communication Skills. Oxford University Press.
2. Wood, F. T. (2007). Remedial English Grammar. Macmillan.
3. Zinsser, William. (2001). On Writing Well. Harper Resource Book.

4. The Four Skills for Communication – Josh Sreedharan – Foundation Books
5. Communicative English – E. Sureshkumar and P. Sreehari – Orient Blackswan

|        |                              |   |   |   |   |
|--------|------------------------------|---|---|---|---|
| MA3102 | ENGINEERING MATHEMATICS – II | L | T | P | C |
|        |                              | 3 | 1 | 0 | 4 |

**Aim:** To impart the fundamental knowledge of Engineering Mathematics to the students in order to achieve a well-founded knowledge about the principles of Mathematics.

**Objective:** To develop basic knowledge to the students in differential equations and vector calculus. This subject is further broadened to the functions of complex variables and complex integration. A thorough knowledge about Laplace transforms is also covered to aid the students solve the differential equations.

| Course Outcome - COs |                                                                    | Cognitive Skill |
|----------------------|--------------------------------------------------------------------|-----------------|
| CO-01                | The Students will be able to solve ordinary differential equations | An , E , S      |
| CO-02                | The Students will be able to solve complex variables               | E               |
| CO-03                | The Students will be able to synthesize complex integration        | S               |
| CO-04                | The Students will be able to solve Vector Calculus                 | E , S           |
| CO-05                | The Students will be able to Synthesize Laplace transforms         | S               |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | P<br>O<br>-<br>B | PO<br>-C | PO<br>-D | PO<br>-E | PO<br>-F | PO<br>-G | PO<br>-H | P<br>O<br>-<br>I | PO-<br>J | PO<br>-k | PO<br>-L |
|----------|------|------------------|----------|----------|----------|----------|----------|----------|------------------|----------|----------|----------|
| CO-01    | M    | S                | M        | S        | S        | N        | M        | M        | S                | S        | M        | M        |
| CO-02    | S    | M                | L        | N        | L        | M        | S        | L        | L                | S        | M        | M        |
| CO-03    | S    | L                | S        | S        | L        | L        | S        | S        | M                | M        | S        | S        |
| CO-04    | S    | L                | M        | S        | N        | L        | S        | S        | M                | S        | S        | M        |
| CO-05    | S    | L                | M        | M        | M        | L        | N        | S        | M                | M        | M        | S        |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### UNIT I : ORDINARY DIFFERENTIAL EQUATIONS

9

Linear differential equations of second order with constant and variable coefficients- Cauchy's and Legendre's linear equations – Method of variation of parameters.

#### UNIT II: COMPLEX VARIABLES

9

Functions of a complex variable – Analytic function – Necessary conditions- Cauchy- Riemann equations in cartesian and polar co-ordinates - Sufficient conditions (excluding proof) –Properties

of analytic function – Harmonic and its conjugate – Construction of analytic function by Milne Thomson method – Conformal mappings  $w = z + c$ ,  $cz$ ,  $1/z$  and Bilinear transformation.

### UNIT III: COMPLEX INTEGRATION

9

Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Laurent's expansion – Singular points – Residues – Cauchy's Residue theorem – Evaluation of real definite

integral using contour integration(excluding poles on the real axis) -  $\int_0^{2\pi} f(\cos \theta, \sin \theta) d\theta$  and

$$\int_{-\infty}^{\infty} \frac{f(x)}{g(x)} dx$$

### UNIT IV: VECTOR CALCULUS

9

Gradient, Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelepipeds.

### UNIT V: LAPLACE TRANSFORMS

9

Laplace transform –Existence condition– Transforms of elementary functions – Basic properties – Transforms of derivatives and integrals – Transform of Periodic functions. Inverse Laplace transform – Convolution, Initial and Final value theorems (statement only) – Solutions of linear ordinary differential equation of second order with constant coefficients using Laplace transform techniques.

**L: 45 + T: 15 = TOTAL 60 HOURS**

#### TEXT BOOKS:

1. Grewal B.S., "Higher Engineering Mathematics"- 40<sup>th</sup> Edition, Khanna Publishers, Delhi 2007.

#### REFERENCES:

2. M.Immaculate Mary , K.Uma Samundesvari, Engineering Mathematics – II" First Edition, Anuradha Publications, ,2013.
3. Erwin Kreyszig, " Advanced engineering Mathematics", Seventh Edition, Wiley India, 2007.
4. Veerarajan T, " Engineering Mathematics (for first year)", Tata McGraw- Hill Publishing Company Ltd.,New Delhi,2007.
5. P.Kandasamy , K.Thilagavathy , K.Gunavathy" Engineering Mathematics" S.Chand & Company Ltd.2002.
6. B.V. Ramana,"Higher Engineering Mathematics" Second Edition Tata McGraw- Hill, Publishing Company Ltd., New Delhi, 2006.

| BE3101 | BASIC ELECTRICAL AND ELECTRONICS<br>ENGINEERING | L | T | P | C |
|--------|-------------------------------------------------|---|---|---|---|
|        |                                                 | 3 | 0 | 0 | 3 |

#### AIM :

To understand the basic concepts of AC and DC circuits, measuring instruments, electronic devices and Communication system.

**OBJECTIVES:**

- To understand the basic solutions of AC and DC circuits.
- To study the basic principle and operation of AC and DC machines.
- To study the fundamental operations of measuring instruments.
- To study the layout of power system
- To understand the fundamental operation and characteristics of Electron devices
- To understand the implementation of Boolean expression using logic gates.
- To become familiar with basic concepts of Communication system.

| Course Outcome – Cos |                                                                                                          | Cognitive Skill |
|----------------------|----------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Ohms Law, Kirchhoff's laws, Mesh and Nodal Analysis for DC Circuits. Introduction to AC Circuit          | R               |
| CO-02                | Operating principles of Moving coil and Moving iron instruments (Ammeter and voltmeter),                 | U               |
| CO-03                | Introduction to Semiconductors, PN Junction diode-Zener diode and its characteristics-Half wave          | A               |
| CO-04                | Number systems-binary arithmetic--Boolean algebra-laws and theorems-Simplification of Boolean expression | A               |
| CO-05                | Block diagram of basic communication system-need for modulation-Types of modulation                      | E               |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | S    | N    | N    | M    | N    | N    | N    | L    | M    | N    |
| CO-02    | S    | M    | S    | N    | M    | M    | N    | N    | L    | L    | M    | N    |
| CO-03    | S    | S    | S    | N    | N    | M    | N    | N    | N    | L    | M    | N    |
| CO-04    | S    | S    | S    | N    | N    | M    | N    | N    | N    | L    | M    | N    |
| CO-05    | S    | S    | S    | N    | N    | M    | N    | N    | N    | L    | M    | N    |

S- Strong, M- Medium, L-Low, N- Not Relevant

**UNIT: 1 – ELECTRICAL CIRCUITS****9**

Ohms Law, Kirchhoff's laws, Mesh and Nodal Analysis for DC Circuits.

Introduction to AC Circuits, Faraday's Law of Electromagnetic Induction, Lenz law, Inductor, Capacitor, Power factor, Waveforms and RMS value, Average Value, Peak factor and Form factor, Single phase circuits- Series and Parallel, Three phase balanced circuits. Fundamentals of wiring and earthing.

## **UNIT: II – ELECTRICAL MEASUREMENTS, MACHINES AND POWER SYSTEM**

**9**

Operating principles of Moving coil and Moving iron instruments (Ammeter and voltmeter), Dynamometer type watt meter and Energy meter, Errors in Measurements.

Construction, Principle of operation and Applications of DC Generators, DC Motors, Single phase transformers. Structure of power system.

## **UNIT- III SEMICONDUCTOR DEVICES**

**9**

Introduction to Semiconductors, PN Junction diode-Zener diode and its characteristics-Half wave and Full wave Rectifiers-Bipolar Junction transistor-CB,CE,CC Configuration and characteristics-JFET and MOSFET construction, operation ,characteristics (CS only) and uses.

## **UNIT-IV DIGITAL ELECTRONICS**

**9**

Number systems-binary arithmetic--Boolean algebra-laws and theorems-Simplification of Boolean expression- logic gates –Implementation of Boolean expression using logic gates-standard forms of Boolean expression.

## **UNIT – V COMMUNICATION SYSTEMS**

**9**

Block diagram of basic communication system-need for modulation-Types of modulation-Principles of Amplitude and Frequency modulation – pulse analog and digital modulation-AM and FM transmitter and receiver(Block diagram description only) –Satellite Communication Radar Systems-Data transmission and MODEM.

**TOTAL: 45 HOURS**

### **REFERENCES:**

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, “Basic Electrical, Electronics and Computer Engineering”, Tata McGraw Hill, Second Edition, (2006).
2. V.N. Mittle “Basic Electrical Engineering”, Tata McGraw Hill Edition, New Delhi, 1990.
3. V.K.Mehta “Principles of Power System”, S.Chand & Company Ltd, New Delhi, 2001.
4. R.S.Sedha,”Applied electronics”S.Chand&Co.,2006.

| BE3102 | BASIC CIVIL AND MECHANICAL ENGINEERING | L | T | P | C |
|--------|----------------------------------------|---|---|---|---|
|        |                                        | 3 | 0 | 0 | 3 |

### **AIM:**

To impart the fundamental knowledge in Basic Civil and Mechanical Engineering.

### **OBJECTIVES:**

To enable the students to understand the Basic Civil and Mechanical Engineering concepts.

**Course Outcomes:**

| Course Outcome - COs |                                                                                                                                                | Cognitive Skill |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | To understand the <b>Surveying:</b> Objects – types – classification – principles – measurements of distances – angles –leveling–determination | R,U,A           |
| CO-02                | To understand the Types, Bearing capacity– Requirement of good foundation                                                                      | R,U,A           |
| CO-03                | To understand the Statics –Basics Concepts, Fundamental principles & concepts: Newton’s laws, gravitation, force, couple,                      | R,U,A           |
| CO-04                | To understand the Introduction to IC Engines, Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles,              | R,U,A,          |
| CO-05                | To understand the Foundry-Investment casting, Die casting, Centrifugal casting, Continuous casting, Stir casting, Squeeze casting.             | R,U,A           |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

**Mapping of Course Outcome with Programme Outcome**

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k |
|----------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | L    | L    | M    | L    | L    | L    | M    | M    | L    |
| CO-02    | M    | N    | M    | L    | N    | M    | L    | L    | S    | M    | L    |
| CO-03    | S    | M    | L    | L    | N    | M    | L    | L    | L    | N    | M    |
| CO-04    | S    | L    | M    | M    | N    | M    | M    | L    | N    | M    | M    |
| CO-05    | S    | L    | N    | M    | N    | M    | L    | L    | M    | M    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

**A– CIVIL ENGINEERING****UNIT I: SURVEYING AND CIVIL ENGINEERING MATERIALS 9**

**Surveying:** Objects – types – classification – principles – measurements of distances – angles – leveling–determination of areas–illustrative examples.

**Civil Engineering Materials:** Bricks–stones–sand–cement–concrete–steel sections.

**UNIT II: BUILDING COMPONENTS AND STRUCTURES 9**

**Foundations:** Types, Bearing capacity– Requirement of good foundations.

**Superstructure:** Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring –plastering – Mechanics – Internal and external forces – stress – strain – elasticity – Types of Bridges and Dams–Basics of Interior Design and Landscaping.

**B– MECHANICAL ENGINEERING****UNIT III: FUNDAMENTALS OF ENGINEERING MECHANICS 9**

Statics –Basics Concepts, Fundamental principles & concepts: Newton’s laws, gravitation, force, couple, moment (about point and about axis), Varignon’s theorem, resultant of concurrent and non-concurrent coplanar forces, Problem formulation concept; 2-D statics, two and three force members, alternate equilibrium equations, 3-D statics.

**UNIT IV: BASIC CONCEPTS OF THERMAL ENGINEERING****9**

Introduction to IC Engines, Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles, Working principle of steam, Gas, Diesel, Hydro-electric and Nuclear Power plants, Principle of vapour compression and absorption system.

**UNIT V: BASIC MANUFACTURING PROCESSES****9**

Foundry-Investment casting, Die casting, Centrifugal casting, Continuous casting, Stir casting, Squeeze casting. Metal fusion welding processes- Oxyfuel gas welding – Arc welding processes. Additive Manufacturing-3D Printing.

**TOTAL: 45 HOURS****TEXT BOOKS:**

1. Shanmugam G and Palanichamy MS, “Basic Civil and Mechanical Engineering”, Tata McGraw Hill Publishing Co., New Delhi,(1996).
2. Ramamrutham S., “Basic Civil Engineering”, DhanpatRai Publishing Co.(P)Ltd. (1999).

**REFERENCES:**

1. Seetharaman S., “Basic Civil Engineering”, Anuradha Agencies,(2005).
2. Venugopal K. and Prahu Raja V., “Basic Mechanical Engineering”, Anuradha Publishers, Kumbakonam,(2000).
3. Shantha KumarSRJ., “Basic Mechanical Engineering”, Hi-tech Publications, Mayiladuthurai,(2000).

| ME3101 | ENGINEERING GRAPHICS | L | T | P | C |
|--------|----------------------|---|---|---|---|
|        |                      | 3 | 0 | 2 | 4 |

**AIM:**

To impart the fundamental knowledge of Engineering Graphics to the students in order to achieve a well-founded knowledge about the principles of Engineering Graphics.

**OBJECTIVE:**

- To develop skills for communication of concepts, ideas and design of Engineering Products.
- To expose them to existing national standards related to technical drawings

| Course Outcome - COs |                                                                                                                                                                | Cognitive Skill |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Students should able to understand the Use of drafting instruments, BIS conventions and specifications – Size, layout and folding of drawing sheets            | U               |
| CO-02                | Students should able to Projection of points, Projection of straight lines located in the first quadrant. Determination of true lengths and true inclinations. | A               |
| CO-03                | Students should able to understand the Prisms, pyramids, cylinder and cone, axis perpendicular to any one reference plane. Axis parallel to both the planes    | U               |
| CO-04                | Students should able to Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone, Isometric view,                                   | E               |
| CO-05                | Students should able to understand the Fundamental of projection along with classification, Projections from the pictorial view of the object                  | R               |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-<br>A | PO-<br>B | PO-<br>C | PO-<br>D | PO-<br>E | PO-<br>F | PO-<br>G | PO-<br>H | PO-<br>I | PO-<br>J | PO-<br>k | PO-<br>L |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| CO-01    | S        | M        | M        | M        | M        | M        | M        | M        | M        | M        | L        | M        |
| CO-02    | S        | S        | M        | M        | M        | M        | M        | M        | M        | M        | L        | M        |
| CO-03    | S        | S        | M        | M        | M        | M        | M        | M        | M        | M        | L        | M        |
| CO-04    | S        | S        | M        | M        | M        | M        | M        | M        | M        | M        | L        | M        |
| CO-05    | S        | M        | M        | M        | M        | M        | M        | M        | M        | M        | L        | M        |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### Unit I : Introduction

9

**Concepts and conventions:** Use of drafting instruments, BIS conventions and specifications – Size, layout and folding of drawing sheets, Lettering and dimensioning. General principles of orthographic projection, First angle projection – Layout of views. **(Not for examination)**

#### General Plane Curves

Conic sections including the Rectangular Hyperbola (General method); Cycloid, Epicycloid, Hypocycloid and Involute.

#### Unit II: Projection of Points, Lines & Planes

9

Projection of points, Projection of straight lines located in the first quadrant. Determination of true lengths and true inclinations. Projection of planes- parallel to any one reference plane, perpendicular to any one reference plane, Inclined to any one reference plane and inclined to both reference planes

#### Unit III : Projection of Solids & Section of Solids

9

Prisms, pyramids, cylinder and cone, axis perpendicular to any one reference plane. Axis parallel to both the planes. Axis inclined to any one reference plane.

Sectioning of solids- Prisms, pyramids, cylinder and cone in simple vertical position by cutting planes inclined to one reference plane. Obtaining the true shape of section

#### Unit IV: Development of Surfaces & Isometric Projection

9

Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone, Isometric view, Isometric scale to draw Isometric projection, Non-Isometric lines, construction of Isometric view from given orthographic views and to construct Isometric view of a Pyramid, Cone, Sphere.

#### Unit V: Orthographic Projection & Perspective Projection

9

Fundamental of projection along with classification, Projections from the pictorial view of the object on the principal planes for view from front, top and sides using first angle projection method and third angle projection method, full sectional view. Perspective Projection of Solids (Any one Method).

**L: 45+P: 15 = TOTAL: 60 HOURS**

**TEXT BOOKS:**

1. Venugopal K and Prabhu Raja V, “*Engineering Graphics*”, New Age International Publishers, 2007.
2. Luzadder W J, “*Fundamentals of Engineering Drawing*”, Prentice Hall Book Co., New York, 1998
3. Bhat, N.D.& M. Panchal , *Engineering Drawing*, Charotar Publishing House,2008

**REFERENCES:**

1. Kumar M S, “*Engineering Graphics*”, Ninth Edition, DD Publications, Chennai, 2007.
2. Bureau of Indian Standards, “*Engineering Drawing Practices for Schools and Colleges SP 46-2003*”, BIS, New Delhi, 2003.
3. Shah, M.B. & B.C. Rana , *Engineering Drawing and Computer Graphics*, Pearson Education,2008

|        |                                                                    |          |          |          |          |
|--------|--------------------------------------------------------------------|----------|----------|----------|----------|
| BE3171 | <b>BASIC ELECTRICAL AND ELECTRONICS ENGINEERING<br/>LABORATORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|        |                                                                    | <b>0</b> | <b>0</b> | <b>2</b> | <b>1</b> |

**AIM:**

To understand the electric circuit connection, measurement of electrical parameters, Characteristics of electron devices and its applications.

**OBJECTIVES:**

- To make basic electrical connection
- To measure the electrical parameters
- To obtain the characteristics of Electron devices
- To verify the operation of logic gates.

| Course Outcome - COs |                                                                                                    | Cognitive Skill |
|----------------------|----------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Study of Symbols, Cables and Earthing.                                                             | U,An            |
| CO-02                | Residential house wiring using switches, fuse, indicator, lamp and energy meter.                   | U,An            |
| CO-03                | Fluorescent lamp wiring.                                                                           | U,An            |
| CO-04                | Stair case wiring / Lamp control from three different places/ Doctor Room control/ Go down control | A,An            |
| CO-05                | Measurement of electrical quantities                                                               | A,An            |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

**Mapping of Course Outcome with Programme Outcome**

| PO \ CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|---------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01   | S    | S    | S    | L    | L    | M    | M    | M    | L    | S    | S    | L    |
| CO-02   | S    | S    | M    | L    | L    | M    | S    | S    | L    | S    | S    | L    |
| CO-03   | S    | S    | S    | L    | L    | M    | M    | M    | L    | S    | S    | L    |
| CO-04   | S    | S    | S    | L    | L    | M    | M    | S    | L    | S    | S    | L    |
| CO-05   | S    | S    | M    | L    | L    | M    | S    | S    | L    | S    | S    | L    |

S- Strong, M- Medium, L-Low, N- Not Relevant

**I. Electrical Engineering Lab**

- 1 Study of Symbols, Cables and Earthing.
- 2 Residential house wiring using switches, fuse, indicator, lamp and energy meter.
- 3 Fluorescent lamp wiring.
- 4 Stair case wiring / Lamp control from three different places/ Doctor Room control/ Go down control
- 5 Measurement of electrical quantities – voltage, current, power & computation of power factor in RLC circuit.
- 6 Measurement of energy using single phase energy meter.
- 7 Fan Wiring.

**II. Electronics Engineering Lab**

1. Study of Electronic components and equipments – Resistor, colour coding, Measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
2. Characteristics of PN Junction diode
3. Characteristics of Zener diode
4. Voltage Regulator using Zener diode
5. Measurement of ripple factor of HWR and FWR.
6. Study of logic gates AND, OR, EX-OR and NOT, NAND and NOR.
7. Generation of Clock Signal.
8. Soldering practice – Components, Devices and Circuits – Using general purpose PCB.

**TOTAL: 30 HOURS**

|               |                                               |          |          |          |          |
|---------------|-----------------------------------------------|----------|----------|----------|----------|
| <b>BE3172</b> | <b>BASIC CIVIL AND MECHANICAL ENGINEERING</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               | <b>LABORATORY</b>                             | <b>0</b> | <b>0</b> | <b>2</b> | <b>1</b> |

**AIM:**

To gain fundamental knowledge in basic Engineering practices of Civil and Mechanical Engineering.

**OBJECTIVES:**

To provide exposure to the students with hands on experience on various basic Engineering practices in Civil & Mechanical Engineering.

**OUTCOMES:**

| <b>Course Outcome - COs</b> |                                                                                                                                 | <b>Cognitive Skill</b> |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO-01                       | Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in house hold fittings. | U,An                   |
| CO-02                       | Study of pipe connections requirements for pumps and turbines.                                                                  | U,An                   |
| CO-03                       | Preparation of plumbing line sketches for water supply and sewage works.                                                        | U,An                   |
| CO-04                       | Preparation of arc welding of butt joints, lap joints and tee joints.                                                           | A,An                   |
| CO-05                       | Demonstration on foundry, fitting and sheet metal exercises.                                                                    | A,An                   |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-<br>A | PO-<br>B | PO-<br>C | PO-<br>D | PO-<br>E | PO-<br>F | PO-<br>G | PO-<br>H | PO-<br>I | PO-<br>J | PO-<br>k | PO-<br>L |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| CO-01    | S        | L        | M        | M        | L        | M        | M        | M        | L        | S        | S        | L        |
| CO-02    | S        | S        | S        | L        | L        | M        | S        | S        | L        | S        | S        | L        |
| CO-03    | S        | S        | S        | M        | L        | S        | M        | M        | L        | S        | S        | L        |
| CO-04    | S        | S        | M        | L        | S        | M        | M        | S        | L        | S        | S        | L        |
| CO-05    | S        | S        | S        | L        | S        | M        | S        | S        | L        | S        | S        | L        |

S- Strong, M- Medium, L-Low, N- Not Relevant

## I CIVIL ENGINEERING PRACTICE

### Buildings:

- (a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

### Plumbing Works:

- (a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in house hold fittings.
- (b) Study of pipe connections requirements for pumps and turbines.
- (c) Preparation of plumbing line sketches for water supply and sewage works.
- (d) Hands-on-exercise:  
Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.
- (e) Demonstration of plumbing requirements of high-rise buildings.

### Carpentry using Power Tools only:

- (a) Study of the joints in roofs, doors, windows and furniture.
- (b) Hands-on-exercise:  
Wood work, joints by sawing, planing and cutting.

## II MECHANICAL ENGINEERING PRACTICE

### Welding:

Preparation of arc welding of butt joints, lap joints and tee joints.

### Basic Machining:

Simple Turning and Taper turning

### Dynamics:

Experiment using Gyroscope / Four bar link mechanism.

### Demonstration on:

- (a) Demonstration on foundry, fitting and sheet metal exercises.
- (b) Demonstration on the working principle of two stroke and four stroke I.C. engines.

**TOTAL: 30 HOURS**

### SEMESTER III

| SL. NO            | COURSE CODE | COURSE TITLE                                  | L         | T        | P         | C         |
|-------------------|-------------|-----------------------------------------------|-----------|----------|-----------|-----------|
| <b>THEORY</b>     |             |                                               |           |          |           |           |
| 1.                | MA3201      | Engineering Mathematics-III                   | 3         | 1        | 0         | 4         |
| 2.                | ME3201      | Engineering Mechanics                         | 2         | 1        | 0         | 3         |
| 3.                | ME3203      | Engineering Thermodynamics                    | 3         | 0        | 0         | 3         |
| 4.                | ME3204      | Fluid Mechanics and Machinery                 | 3         | 0        | 0         | 3         |
| 5.                | ME3205      | Manufacturing Processes-I                     | 3         | 0        | 0         | 3         |
| 6.                | EE3203      | Electrical Engineering and Control            | 3         | 0        | 0         | 3         |
| <b>PRACTICALS</b> |             |                                               |           |          |           |           |
| 7.                | ME3271      | CAD and Modelling Laboratory                  | 0         | 0        | 3         | 1         |
| 8.                | ME3272      | Fluid Mechanics and Machinery Laboratory      | 0         | 0        | 3         | 1         |
| 9.                | ME3273      | Manufacturing Processes Laboratory-I          | 0         | 0        | 3         | 1         |
| 10                | EE3272      | Electrical Engineering and Control Laboratory | 0         | 0        | 3         | 1         |
| <b>TOTAL</b>      |             |                                               | <b>17</b> | <b>2</b> | <b>12</b> | <b>23</b> |

|               |                                    |          |          |          |          |
|---------------|------------------------------------|----------|----------|----------|----------|
| <b>MA3202</b> | <b>ENGINEERING MATHEMATICS III</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                    | <b>3</b> | <b>1</b> | <b>0</b> | <b>4</b> |

**Aim:**

To impart the fundamental knowledge of Engineering Mathematics to the students in order to achieve a well-founded knowledge about the principles of Mathematics.

**Objective:**

To develop the skill of the students in the areas of boundary value problems and Transform techniques. This will be necessary for their effective studies in a large number of Engineering subjects like heat conduction, communication systems, electro-optics and electromagnetic theory. This course will also serve as a prerequisite for post graduate and specialized studies and research.

| <b>Course Outcomes</b><br>At the end of the course students should be able to |                                                                                                                                                                                                                                                                           | <b>Cognitive Skills</b> |
|-------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| CO-01                                                                         | Recognize a Partial Differential Equation and formulate a Partial Differential Equation from a given equation. Solve linear Partial Differential Equation of both first and second order using various methods.                                                           | R,U,A,An,<br>E, S       |
| CO-02                                                                         | Derive a Fourier series expansion for a given periodic function by evaluating Fourier coefficient and expand Fourier cosine and Sine series for given function. Also find the Fourier series expansion for a given set of numerical values by applying harmonic analysis. | R,U,A,An,<br>E, S       |
| CO-03                                                                         | Classify the second order Partial Differential Equation and solve second order Partial Differential Equations such as wave equation, heat equation and Laplace equation with boundary and initial conditions applying Fourier series expansion.                           | R,U,A,An,<br>E, S       |
| CO-04                                                                         | Know fundamental and mathematical properties of Fourier transform. Calculate the Fourier transform of a given function and inverse Fourier transform of function. Know the applications of Parseval's and convolution theorem.                                            | R,U,A,An,<br>E, S       |
| CO-05                                                                         | Understand the characteristics and properties of Z-transform. Compute Z-transform of simple functions and inverse z transform of given functions and apply Z-transform for solving difference equations.                                                                  | R,U,A,An,<br>E, S       |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

#### Mapping of Course Outcome with Programme Outcome

| <b>PO<br/>CO</b> | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L | PO-M |
|------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| <b>CO-01</b>     | S    | M    | S    | M    | S    | S    | S    | S    | M    | S    | S    | M    |      |
| <b>CO-02</b>     | S    | M    | M    | M    | S    | S    | M    | S    | M    | M    | M    | M    |      |
| <b>CO-03</b>     | S    | M    | M    | M    | S    | S    | M    | M    | M    | S    | S    | M    |      |
| <b>CO-04</b>     | S    | M    | S    | M    | S    | M    | S    | S    | M    | S    | S    | M    |      |
| <b>CO-05</b>     | S    | M    | S    | M    | S    | M    | S    | S    | M    | S    | S    | M    |      |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### UNIT I: Partial Differential Equations

12

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solutions of Clairaut's equations – Lagrange's linear equation –Homogeneous linear partial differential equations of second order with constant coefficients.

#### UNIT II: Fourier Series

12

Dirichlet's conditions – Fourier series – Change of interval - Odd and Even functions – Half range sine and cosine series – Parseval's identity – Harmonic Analysis.

**UNIT III: Boundary Value Problems****12**

Classification of second order linear partial differential equations – One dimensional wave and heat equations – Assumptions – Fourier series solution – Steady state solution of two dimensional heat equation (insulated edges excluded) – Fourier series solution in Cartesian co-ordinates.

**UNIT IV: Fourier Transforms****12**

Statement and meaning of Fourier integral theorem – Fourier transform — Properties - Inverse Fourier transform – Fourier Sine and Cosine transforms – Inverse sine and cosine transforms – Properties -Transforms of simple functions – Convolution theorem – Parseval's identity.

**UNIT V: Z-Transforms****12**

Z- transform – Elementary properties – convolution theorem-Inverse Z-transform –Partial fraction Method, Inversion integral method and Convolution – Initial and Final value theorems –Formation of difference equations – Solution of difference equations using Z-transform

**L: 45 + T: 15, TOTAL: 60 HOURS****Text Book**

1. Grewal B.S., “Higher Engineering Mathematics” – 40<sup>th</sup> Edition , Khanna Publishers, Delhi 2011.

**References**

1. Erwin Kreyszig, “Advanced Engineering Mathematics”, 10<sup>th</sup> Edition, John Wiley & Sons, Inc., USA, 2011.
2. Kandasamy P, Thilagavathy K, and Gunavathy K., “Engineering Mathematics Volume III”, First Edition, S.Chand & Company Ltd., New Delhi.
3. Veerarajan T., “Engineering Mathematics (for Semester III), Third Edition, Tata McGraw – Hill Publishing Company Limited, New Delhi 2007.
4. Bali, N.P. and Manish Goyal, A Text Book of Engineering Mathematics, Seventh Edition, Lakshmi Publications Pvt. Ltd., New Delhi, 2009.

| ME3201 | ENGINEERING MECHANICS | L | T | P | C |
|--------|-----------------------|---|---|---|---|
|        |                       | 2 | 1 | 0 | 3 |

**AIM**

To impart the fundamental knowledge of Engineering Mechanics to the students in order to achieve a well-founded knowledge about the principles of mechanics

**OBJECTIVE**

This is a basic engineering course common to all branches to inculcate in the students, problem solving abilities and to enhance their analytical abilities.

**Course Outcome:**

| Course Outcome - COs |                                                                                     | Cognitive Skill |
|----------------------|-------------------------------------------------------------------------------------|-----------------|
| CO-01                | Calculate Resultant force for different force systems                               | R,U,A,An,E      |
| CO-02                | Carryout equilibrium analysis of truss                                              | R,U,A,An,E      |
| CO-03                | Calculate C.G & Centre of mass for simple and composite figures                     | R,U,A,An,E      |
| CO-04                | Apply Newton's law & conservation law to elastic collision & motion of rigid bodies | R,U,A,An,E      |
| CO-05                | Apply the principles of dynamics to solve engineering problem                       | R,U,A,An,E      |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

**Mapping of Course Outcome with Programme Outcome**

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-K | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | M    | L    | L    | L    | L    | L    | L    | L    | S    | L    |
| CO-02    | S    | M    | M    | L    | L    | L    | L    | L    | L    | L    | S    | L    |
| CO-03    | S    | M    | M    | L    | L    | L    | L    | L    | L    | L    | S    | L    |
| CO-04    | S    | M    | L    | L    | L    | L    | L    | L    | L    | L    | S    | L    |
| CO-05    | S    | M    | L    | L    | L    | L    | L    | L    | L    | L    | S    | L    |

S- Strong, M- Medium, L-Low, N- Not Relevant

**UNIT I: Statics of Particles****10**

Statics –Basics Concepts, Fundamental principles & concepts: Vector algebra, Newton's laws, gravitation, force (external and internal, transmissibility), couple, moment (about point and about axis), Varignon's theorem, resultant of concurrent and non-concurrent coplanar forces, static equilibrium, free body diagram, reactions. Problem formulation concept; 2-D statics, two and three force members, alternate equilibrium equations, constraints and static determinacy; 3-D statics.

**UNIT II: Application of Statics & Friction****9**

Analysis of Structures- Trusses: Assumptions, rigid and non-rigid trusses; Simple truss (plane and space), analysis by method of joints. Analysis of simple truss by method of sections;

**FRICTION:** Friction- Coulomb dry friction laws, simple surface contact problems, friction angles, types of problems, wedges. Sliding friction and rolling resistance

**UNIT III : Centroid, Centre of Gravity and Moment of Inertia****8**

Moment of Inertia- First moment of mass and center of mass, centroids of lines, areas, volumes, composite bodies. Area moments and products of inertia, radius of gyration, transfer of axes, composite areas. Rotation of axes, principal area-moments of inertia, Second moment of mass, Mass moments and products of inertia, radius of gyration, transfer of axes, flat plates (relation between area and mass moments and products of inertia), composite bodies. Rotation of axes, principal mass moments of inertia.

**UNIT IV : Particle Dynamics****8**

Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2<sup>nd</sup> law (rectangular, path, and polar coordinates). Work, kinetic energy, power, potential energy. Impulse-momentum (linear, angular); Impact (Direct and oblique).

**UNIT V: Kinematics & Kinetics of Rigid Bodies:****10**

Plane kinematics of rigid bodies- Rotation; Parametric motion. Relative velocity, instantaneous center of rotation. Relative acceleration, rotating reference frames. 3-part velocity and 5-part acceleration relations, Coriolis acceleration.

Plane kinetics of rigid bodies- Kinetics of system of particles and derivation of moment equation. Translation. Fixed axis rotation; General planar motion.

**TOTAL: 45 HOURS****TEXT BOOKS:**

1. Beer F P and Johnson E R, "Vector Mechanics for Engineers, Statics and Dynamics", Tata Mc-Graw Hill Publishing Co. Ltd., New Delhi, 2006.
2. Tayal A K, "Engineering Mechanics- Statics and Dynamics" , Umesh Publications, Delhi, 2004
3. Irving H. Shames, Engineering Mechanics, Prentice Hall, New Delhi 1997.

**REFERENCES:**

1. Bansal R K, "Engineering Mechanics", Laxmi Publications Pvt. Ltd., New Delhi, 2006.
2. Bhavikatti S S, "Engineering Mechanics", New Age International Pvt. Ltd., New Delhi, 2003.
3. Young D H and Timashenko S, "Engineering Mechanics", Tata McGraw-Hill, Fourth Edition, 2006.
4. Jivan Khachane, Ruchi Shrivastava, "Engineering Mechanics: Statics and Dynamics", ANE Books, 2006.
5. Rajasekaran S and Sankarasubramanian G, "Engineering Mechanics-Statics and Dynamics", Vikas Publishing House Pvt. Ltd., New Delhi, 2006.
6. NPTEL courses: <http://nptel.iitm.ac.in/courses.php>, web and video resources on Engineering Mechanics.

|               |                                   |          |          |          |          |
|---------------|-----------------------------------|----------|----------|----------|----------|
| <b>ME3203</b> | <b>ENGINEERING THERMODYNAMICS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                   | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**AIM**

To impart the fundamental knowledge of engineering thermodynamics to the students in order to achieve a well-founded knowledge about the principles of thermodynamics.

**OBJECTIVES:**

To familiarize the students to understand the fundamentals of thermodynamics and to perform thermal analysis on their behavior and performance. (Use of Standard and approved Steam Table, Mollier Chart, Compressibility Chart and Psychrometric Chart permitted)

**Course Outcome:**

| Course Outcome - COs |                                                                                              | Cognitive Skill |
|----------------------|----------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Students will understand the basic concept of thermodynamics and first law of thermodynamics | U               |
| CO-02                | Students will study second law of thermodynamic and availability                             | R               |
| CO-03                | Students will know the properties of pure substance and steam power cycle                    | U               |
| CO-04                | Students will study the gas mixture and psychrometry                                         | A               |
| CO-05                | Student will study various thermodynamic cycles                                              | An              |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

**Mapping of Course Outcome with Programme Outcome**

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-K | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | L    | S    | L    | M    | M    | L    | M    | S    | S    | S    | L    |
| CO-02    | S    | L    | S    | L    | M    | M    | L    | M    | S    | S    | S    | L    |
| CO-03    | S    | M    | S    | M    | S    | M    | L    | S    | S    | S    | S    | L    |
| CO-04    | S    | M    | S    | L    | S    | M    | L    | M    | S    | S    | S    | L    |
| CO-05    | S    | M    | S    | L    | M    | M    | L    | M    | S    | S    | S    | L    |

S- Strong, M- Medium, L-Low, N- Not Relevant

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

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

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

Entropy, Principle of Increase Entropy , Second Law of Thermodynamics-Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM of Second kind, Carnot's principle, Carnot cycle and its application, Clausius Inequality, Energy Equation, Availability and Irreversibility.

**UNIT III: PROPERTIES OF PURE SUBSTANCE AND PSYCHROMETRY 9**

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. Atmospheric air - Psychrometric Properties and processes - Psychrometric chart.

**UNIT IV: GAS MIXTURES AND THERMODYNAMICS RELATION 9**

Deviations from perfect Gas Model – Vander Waals Equation of State – Compressibility charts – variable specific heats – Gas Tables. Mixtures of perfect Gases – Mole Fraction, Mass Fraction, Gravimetric and Volumetric Analysis – Dalton's Law of partial pressures, Avogadro's Laws of additive volumes – Mole fraction, Volume fraction and partial pressure, Equivalent Gas constant and Molecular Internal Energy, Enthalpy, Specific Heats and Entropy of Mixture of Perfect Gases and Vapour. Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations, Joule-Thomson Coefficient, Clausius Clapeyron equation, –Elementary Treatment of the Third Law of Thermodynamics.

**UNIT V: THERMODYNAMIC CYCLES 9**

Air standard cycles-Otto cycle, Diesel cycle, Dual cycle, comparison of Otto, diesel, Dual Cycle and Brayton cycle. Ideal and actual Rankine cycles, Cycle Improvement Methods: Reheat and Regenerative cycles

**TOTAL: 45 HOURS**

**TEXT BOOKS:**

1. Nag.P.K., "Engineering Thermodynamics", 6<sup>th</sup> Edition, Tata McGraw-Hill, New Delhi, 2017.
2. Cenge Y Al and Boles M A "Thermodynamics, An Engineering Approach" Tata McGraw Hill, 2019

**REFERENCES:**

1. Kau-Fui Vincent Wong, "Thermodynamics for Engineers", CRC Press, 2011, 2<sup>nd</sup> Edition
2. Holman.J.P., "Thermodynamics", 3<sup>rd</sup> Edition, McGraw-Hill, 1995.
3. Rathakrishnan. E., "Fundamentals of Engineering Thermodynamics", 2<sup>nd</sup> Edition, Prentice-Hall of India Pvt. Ltd, 2006
4. Chattopadhyay, P, "Engineering Thermodynamics", Oxford University Press, 2010.
5. Arora C.P, "Thermodynamics", Tata McGraw-Hill, New Delhi, 2003.
6. Van Wylen and Sonntag, "Classical Thermodynamics", Wiley Eastern, 1987
7. Venkatesh. A, "Basic Engineering Thermodynamics", Universities Press (India) Limited, 2007.

| ME3204 | FLUID MECHANICS AND MACHINERY | L | T | P | C |
|--------|-------------------------------|---|---|---|---|
|        |                               | 3 | 0 | 0 | 3 |

**AIM**

To impart the fundamental knowledge of fluid mechanics and machinery to the students in order to achieve a well-founded knowledge about the principles of fluid mechanics and machinery.

**OBJECTIVES**

- The applications of the conservation laws to flow through pipes and hydraulic machines are studied
- To understand the importance of dimensional analysis.
- To understand the importance of various types of flow in pumps and turbines.

**Course Outcome:**

| Course Outcome - COs |                                                                                          | Cognitive Skill |
|----------------------|------------------------------------------------------------------------------------------|-----------------|
| CO-01                | To understand fluid properties and flow characteristics                                  | U,R             |
| CO-02                | To understand ideal flow & boundary layer theory                                         | U,R             |
| CO-03                | To understand flow through circular pipes and dimensional analysis                       | U,R             |
| CO-04                | To understand hydraulic turbines and their classification                                | U,R             |
| CO-05                | To understand the concept of fluid measurement, types of flows and dimensional analysis. | U,R             |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

**Mapping of Course Outcome with Programme Outcome**

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-K | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | M    | M    | M    | S    | S    | M    | S    | S    | S    | M    |
| CO-02    | S    | S    | M    | M    | M    | S    | S    | M    | S    | S    | S    | M    |
| CO-03    | S    | S    | M    | M    | M    | S    | S    | M    | S    | S    | S    | M    |
| CO-04    | S    | S    | M    | M    | M    | S    | S    | M    | S    | S    | S    | M    |
| CO-05    | S    | S    | M    | M    | M    | S    | S    | M    | S    | S    | S    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

**UNIT I: FLUID PROPERTIES AND FLOW CHARACTERISTICS****9**

Units and dimensions- Properties of fluids. Pressure-height relation for incompressible fluid – Manometers. Bernoulli's equation, applications - Venturi meter, Orifice meter, Pitot tube. Statement of Navier Stokes equation, derivation of Euler's equation.

**UNIT II: IDEAL FLOW& BOUNDARY LAYER THEORY****9**

Types of flow - laminar, turbulent, unsteady, steady, non-uniform and uniform flows. Stream line, streak line and path line. Ideal Flow: Ir-rotational and rotational, stream function, potential function, continuity equation, derivation of three dimensional equation, applications to one dimensional flows steady flow, differential momentum equation. Boundary Layer Theory- D'Alembert paradox, Development of boundary layer, Prandtl's boundary layer equations, Blasius solution.

**UNIT III: FLOW THROUGH CIRCULAR PIPES AND DIMENSIONAL ANALYSIS****9**

Reynolds number, Darcy-Weisbach equation, use of Moody diagram, minor losses-sudden expansion, sudden contraction and losses in pipe fittings, Introduction to CFD: Necessity, limitations, philosophy behind CFD, applications. Dimensional analysis - Buckingham's Pi theorem- applications - similarity laws and models.

**UNIT IV: HYDRAULIC TURBINE:****9**

Hydraulic Turbines- Fluid machines definition and classification. Hydro turbines – definition, classification and flow, specific speed, performance characteristics, study of impulse and reaction turbines. Components of energy transfer- degree of reaction compounding of turbine, governing of turbine.

**UNIT V: PUMPS****9**

Hydraulic Pumps- Classification of pumps and principle of working, Centrifugal pump classifications, working principles, velocity triangles, specific speed, efficiency and performance curves. Reciprocating pump classification, working principles, indicator diagram, work saved by Air vessels and performance curves - working principles of gear and vane pumps-Selection of pumps. Cavitation in pumps.

**TOTAL: 45 HOURS****TEXT BOOK:**

1. Kumar D S, "Fluid Mechanics and Fluid Power Engineering ", Kataria S K and Sons, New Delhi, 6<sup>th</sup> edition, 2008.
2. Robert W Fox, "Introduction to Fluid Mechanics", 10th Edition, John Wiley and sons, Singapore, 2020.

**REFERENCES:**

1. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", McGraw Hill Publishing Co. 9<sup>th</sup> edition 2017
2. NPTEL courses: <http://nptel.iitm.ac.in/courses.php> - web and video resources on Fluid Mechanics.
3. Robert Wife, Alan T. McDonald, Philip J.Pritchard, "Fluid Mechanics and Machinery", 2011.
4. Graebel. W.P, "Engineering Fluid Mechanics", Taylor & Francis, Indian Reprint, 2011
5. John D Anderson, "Computational Fluid Dynamics – The Basics with Applications", McGraw Hill, New Delhi, 1995.

| ME3205 | MANUFACTURING PROCESSES – I | L | T | P | C |
|--------|-----------------------------|---|---|---|---|
|        |                             | 3 | 0 | 0 | 3 |

**AIM**

To impart the fundamental knowledge of manufacturing processes to the students in order to achieve a well-founded knowledge about the principles of manufacturing processes.

**OBJECTIVES:**

To introduce the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and manufacture of plastic components & Composites

**Course Outcome:**

| Course Outcome - COs |                                                                                                                                        | Cognitive Skill |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Acquire the basic knowledge of all manufacturing processes used on shop floor of any industry                                          | R,U             |
| CO-02                | Decide the appropriate production process for any product upon the number of options available to optimize production process.         | R,U,A           |
| CO-03                | Students will understand the relevance and importance of the different manufacturing techniques and real life application in industry. | R,U,A           |
| CO-04                | Report Writing – Characteristics of a Report – Categories of Reports – Letter Writing (Formal Letters)                                 | R,U,A           |
| CO-05                | Select appropriate Joining processes to join work piece                                                                                | A               |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

**Mapping of Course Outcome with Programme Outcome**

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-K | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | M    | L    | L    | S    | M    | S    | M    | S    | S    | S    |
| CO-02    | M    | S    | M    | M    | L    | S    | M    | M    | S    | S    | S    | S    |
| CO-03    | M    | M    | L    | S    | L    | S    | S    | M    | M    | M    | S    | S    |
| CO-04    | M    | S    | L    | M    | L    | S    | M    | S    | S    | M    | S    | L    |
| CO-05    | M    | S    | L    | M    | L    | S    | S    | S    | M    | S    | S    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

**UNIT I: METAL CASTING PROCESSES****9**

Sand Casting : Sand Mould – Type of patterns - Pattern Materials – Pattern allowances –Moulding sand Properties and testing – Cores –Types and applications – Moulding machines– Types and applications; Principle and application of special casting processes : Investment casting, shell moulding, squeeze casting, vacuum casting, counter-gravity low pressure casting and centrifugal casting-Directional and monocrystal solidification - semisolid metal casting - Defects in casting.

**UNIT II: JOINING PROCESSES****9**

Gas Welding: Oxy-acetylene welding, types of flames, welding torches, welding techniques: Arc Welding and Resistance Welding: Arc welding-carbon arc, shielded metal arc, submerged arc, TIG and MIG welding. Welding electrodes-function and characteristics of electrode coating. Resistance welding-spot, seam, projection and butt welding, heat flow in welded components. Other welding process, laser beam welding, electron beam welding, friction welding, Friction stir welding and ultra sonic welding. weld defects: types, causes and cure.

**UNIT III: METAL FORMING PROCESSES****9**

Cold and hot working, rolling, drawing, extrusion and forging, sheet metal cutting, bending. Drawing applications, defects.– Forgingtools and equipment , Press tool works-Basic principles, system, operations and applications. Special forming methods - explosive forming, electro hydraulic forming, magnetic pulse forming – super plastic forming – thermo forming – petro forge hammer and Dynapak process.

**UNIT IV: MANUFACTURING OF PLASTIC COMPONENTS****9**

Different thermosetting and thermoplastic compounds, compression moulding, transfer moulding, injection moulding, film and sheet forming, thermoforming and their applications.

**UNIT V: MANUFACTURING OF COMPOSITES****9**

Fabrication of Metal Matrix Composites: Commonly used Matrices, Basic Requirements in Selection of constituents, solidification processing of composites - XD process, Spray processes - Osprey Process, Rapid solidification processing, Dispersion Processes - Stir-casting & Compo casting, Screw extrusion, Liquid-metal impregnation technique, Principle of molten alloy infiltration, rheological behaviour of meltparticle slurry, Synthesis of In situ Composites; Fabrication of Polymer Matrix Composites - Commonly used Matrices Basic Requirements in selection of Constituents, Moulding method, Low pressure closed moulding, pultrusion, Filament winding, Fabrication of ceramic matrix composites - Various techniques of vapour deposition, Liquid phase method and Hot pressing etc., Fabrication of nano-composites.

**TOTAL: 45 PERIODS****TEXT BOOKS:**

1. Hajra Choudhary S.K and Hajra Choudhury. AK., "Elements of workshop Technology", volume I and II, Media promoters and Publishers Private Limited, Mumbai, 1997.
2. Kalpakjian. S, "Manufacturing Engineering and Technology", Pearson Education India Edition, 8<sup>th</sup> edition 2020.

**REFERENCES:**

1. NPTEL courses, <http://www.nptel.iitm.ac.in/courses.php?disciplineId=112> web and video resources on Manufacturing Processes I.
2. Roy. A. Lindberg, "Processes and Materials of Manufacture", PHI / Pearson education, 2006
3. Paul Degarma E, Black J.T and Ronald A. Kosher, "Materials and Processes, in Manufacturing" eleventh Edition, Prentice – Hall of India, 2012.
4. Krishna K Chawla, "Composite Materials-Science and Engineering", Springer Verlag, New York, 1987.
5. Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", 2<sup>nd</sup> Edition, TMH-2003;
6. ASM Hand Book, "Casting", ASM International, 1998.
7. Nanocomposite Science and Technology, P. M. Ajayan, L. S. Schadler, P. V. Braun, (2003), Wiley-VCH Verlag GmbH Co. KGaA, Weinheim

|        |                                    |   |   |   |   |
|--------|------------------------------------|---|---|---|---|
| EE3203 | ELECTRICAL ENGINEERING AND CONTROL | L | T | P | C |
|        |                                    | 3 | 0 | 0 | 3 |

**AIM:**

This subject is expected to knowledge on basic elements in control systems and develop the mathematical model of the physical systems and to analyze the response and stability of the closed and open loop systems.

**OBJECTIVES:**

To expose the students to the concepts of various types of electrical machines.

**Course Outcome:**

| Course Outcome – Cos |                                                                                                                                                                                   | Cognitive Skill |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Remember the construction and working of any electrical DC machines and transformer under load and unload condition.                                                              | R               |
| CO-02                | Understand the principle of operation and performance of DC machines and transformer.                                                                                             | U               |
| CO-03                | Apply various controls and analyze the responses of DC machine and transformer.                                                                                                   | A               |
| CO-04                | Develop the mathematical model of the physical systems and to analyze the response and stability of the closed and open loop systems. To design the various kinds of compensator. | A               |
| CO-05                | Design different interfacing applications using microcontrollers and peripherals                                                                                                  | E               |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

**Mapping of Course Outcome with Programme Outcome**

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | S    | N    | N    | M    | N    | N    | N    | L    | M    | N    |
| CO-02    | S    | M    | S    | N    | M    | M    | N    | N    | L    | L    | M    | N    |
| CO-03    | S    | S    | S    | N    | N    | M    | N    | N    | N    | L    | M    | N    |
| CO-04    | S    | S    | S    | N    | N    | M    | N    | N    | N    | L    | M    | N    |
| CO-05    | S    | S    | S    | N    | N    | M    | N    | N    | N    | L    | M    | N    |

S- Strong, M- Medium, L-Low, N- Not Relevant

**UNIT I: TRANSFORMERS****9**

Construction, Principle of operation of single phase transformers – emf equation –testing - approximate equivalent circuit - losses - efficiency and regulation.

**UNIT II: DC & AC MACHINES****9**

DC motors - Principle of operation – types - torque equation – Characteristics - speed control - dc motor starters – applications.

AC motors - Construction, principle of operation of synchronous motor, Induction motor –types - speed control - applications.

**UNIT III: SPECIAL MACHINES****9**

Construction, Working Principle of Servomotor - AC & DC, Stepper motor - types, Permanent Magnet DC motor & Universal motor .

**UNIT IV: CONTROL SYSTEMS****9**

Basic elements in control systems, Introduction to linear and non-linear systems – Open and closed loop systems - Transfer function - Modeling of systems - Electrical analogy of mechanical systems - Introduction to P,PI,PID controllers.

**UNIT V: MICROCONTROLLER****9**

Overview of 8051 Architecture; Program Status Register; Structure of Random-Access Memory; Special function registers; Pin configuration and ports structure of 8051 Microcontroller-Instruction Set of 8051.

**TEXT BOOKS**

1. Theory and Performance of Electrical Machines by J.B. Gupta, 1st edition, 2013.
2. Control Systems Engineering by I.J. Nagarath and M.Gopal, 5<sup>th</sup> edition, 2008
3. Kenneth J Ayala, The 8051 Microcontroller Architecture Programming and Application, 2<sup>nd</sup> Edition, Penram International Publishers (India), New Delhi, 1997.
4. Electrical machines by Kothari and Nagarath, TMH Publications, 5<sup>th</sup> edition, 2017.

**REFERENCES:**

1. Mohammed Ali Mazidi and Janice Gillispie Mazidi, The 8051 Microcontroller and Embedded Systems, Pearson Education Asia, New Delhi, 2003.
2. B.L.Theraja, A.K.Theraja “Electrical Technology” Volume 2, 2005

**TOTAL 45 HOURS**

|               |                                     |          |          |          |          |
|---------------|-------------------------------------|----------|----------|----------|----------|
| <b>ME3271</b> | <b>CAD and Modelling Laboratory</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                     | <b>0</b> | <b>0</b> | <b>3</b> | <b>1</b> |

**AIM:**

To implement the basics knowledge about the drawing software AutoCAD and Creo.

**OBJECTIVES:**

To enable the students to understand the basic designing and drafting any 2D and 3D model

**Course Outcomes:**

| <b>Course Outcome - COs</b> |                                                                            | <b>Cognitive Skill</b> |
|-----------------------------|----------------------------------------------------------------------------|------------------------|
| CO-01                       | Understand the importance of drawing                                       | U                      |
| CO-02                       | Develop good knowledge about drawing software AutoCAD and Creo             | U,A                    |
| CO-03                       | Enable the student for designing and drafting any 2D and 3D model          | A                      |
| CO-04                       | Increase the imagination into reality as a product or as a design          | A                      |
| CO-05                       | Increase skill to communicate technical information in the form of drawing | A,An                   |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-K | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | M    | L    | L    | M    | M    | M    | L    | S    | S    | L    |
| CO-02    | S    | S    | M    | L    | L    | M    | S    | S    | L    | S    | S    | L    |
| CO-03    | S    | S    | S    | L    | L    | M    | M    | M    | L    | S    | S    | L    |
| CO-04    | S    | S    | S    | L    | L    | M    | M    | M    | L    | S    | S    | L    |
| CO-05    | S    | S    | M    | L    | L    | M    | S    | S    | L    | S    | S    | L    |

S- Strong, M- Medium, L-Low, N- Not Relevant

### LIST OF EXPERIMENTS

1. Introduction to CAD
2. AUTOCAD – Basics
  - 2.1 Starting with AUTOCAD
  - 2.2 Layout and sketching
  - 2.3 Drawing environment
  - 2.4 Elements of drawing
    - 2.4.1 Draw commands
  - 2.5 3D functions
3. 2D – Figures for practice using AutoCAD
4. Isometric Drawing for practice using AUTOCAD
5. 3-D Solid figures using ACAD
6. Introduction to solid works
  - 6.1 Learning Different Operations like Threading, Sweep, Swept blend.
  - 6.2 Modeling
  - 6.3 Assembling

**TOTAL: 45 PERIODS**

### Important Note

It is compulsory to prepare record of exercises. It must be hand written / hand drawn by student only.

Term work Record content of each experience should include following

- i. Sketches of parts/assemblies.
- ii. Steps followed with commands, its options with numeric values, position of UCS (in case of AUTOCAD), planes selected, etc.
- iii. Printouts of modeled parts/assemblies

|               |                                                 |          |          |          |          |
|---------------|-------------------------------------------------|----------|----------|----------|----------|
| <b>ME3272</b> | <b>FLUID MECHANICS AND MACHINERY LABORATORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                                 | <b>0</b> | <b>0</b> | <b>3</b> | <b>1</b> |

### AIM:

To impart the fundamental knowledge of fluid mechanics and machinery lab to the students in order to achieve a well-founded knowledge about the principles of fluid mechanics and machinery lab

### OBJECTIVES:

Upon Completion of this subject, the students can able to have hands on experience in flow measurements using different devices and also perform calculation related to losses in pipes and also perform characteristic study of pumps, turbines etc.,

**Course Outcome:**

| Course Outcome - COs |                                                                                       | Cognitive Skill |
|----------------------|---------------------------------------------------------------------------------------|-----------------|
| CO-01                | To determine coefficient of discharge of orifice meter and venturi meter              | U, An           |
| CO-02                | To calculate rate of flow using rotameter                                             | U, An           |
| CO-03                | To determine friction factor for a given set of pipes                                 | U, An           |
| CO-04                | To conduct experiments in centrifugal pump and reciprocating pump                     | U, An           |
| CO-05                | To conduct experiments in gear pump, Pelton wheel, Francis turbine and Kaplan turbine | U, An           |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

**Mapping of Course Outcome with Programme Outcome**

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-K | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | M    | L    | L    | M    | S    | M    | S    | S    | S    | L    |
| CO-02    | S    | S    | S    | M    | L    | M    | S    | M    | S    | S    | S    | L    |
| CO-03    | S    | S    | S    | L    | L    | M    | S    | M    | S    | S    | S    | L    |
| CO-04    | S    | S    | S    | L    | L    | M    | S    | M    | S    | S    | S    | L    |
| CO-05    | S    | S    | S    | L    | L    | M    | S    | M    | S    | S    | S    | L    |

S- Strong, M- Medium, L-Low, N- Not Relevant

**LIST OF EXPERIMENTS**

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given venturi meter.
3. Calculation of the rate of flow using Rota meter/Mass flow meter.
4. Determination of friction factor for a given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump/submersible pump
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.
11. Model study in wind tunnel.

**TOTAL: 30 HOURS**

|        |                                        |   |   |   |   |
|--------|----------------------------------------|---|---|---|---|
| ME3273 | MANUFACTURING PROCESSES LABORATORY – I | L | T | P | C |
|        |                                        | 0 | 0 | 3 | 1 |

**AIM:**

To implement the basics knowledge about the machining time for milling and drilling process. .

**OBJECTIVE**

- To impart practical training to the students on various welding processes
- To develop procedural and manual skills in machining and also to provide training in making greensand moulds

**Course Outcomes:**

| Course Outcome - COs |                                                                                            | Cognitive Skill |
|----------------------|--------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Student will be able to choose machining processing to manufacture any component           | U,A             |
| CO-02                | Student will be able to Estimate machining time for milling and drilling process.          | U,A             |
| CO-03                | Student will be able to understand finishing processes                                     | U,A             |
| CO-04                | Student will be able to calculate forces during orthogonal metal cutting.                  | U,A,AN          |
| CO-05                | Student will be able to explain principle and applications of advanced machining processes | R,U,AN          |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

**Mapping of Course Outcome with Programme Outcome**

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | M    | L    | L    | S    | M    | S    | M    | S    | S    | S    |
| CO-02    | S    | S    | M    | M    | L    | S    | M    | M    | S    | S    | S    | S    |
| CO-03    | S    | M    | S    | S    | L    | S    | S    | M    | M    | M    | S    | S    |
| CO-04    | S    | S    | S    | M    | L    | S    | M    | S    | S    | M    | S    | L    |
| CO-05    | S    | S    | M    | M    | L    | S    | S    | S    | M    | S    | S    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

**LIST OF EXPERIMENTS**

1. Facing, plain turning and step turning
2. Drilling and taper turning
3. Grooving, chamfering and knurling
4. Thread cutting operation – external and internal
5. Demonstration of press operations
6. Horizontal and Vertical Welding.
7. Gas Cutting, Gas Welding
8. Mould with solid, split patterns
9. Mould with loose-piece pattern
10. Mould with Core
11. Fabrication of a job involving turning, drilling, milling and welding
12. Visit to industry to study any one of the manufacturing process and submission its report.

**TOTAL: 30 HOURS**

|               |                                               |          |          |          |          |
|---------------|-----------------------------------------------|----------|----------|----------|----------|
| <b>EE3272</b> | <b>ELECTRICAL ENGINEERING AND CONTROL LAB</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                               | <b>0</b> | <b>0</b> | <b>2</b> | <b>1</b> |

### AIM:

To impart the fundamental knowledge of electrical mechanics to the students in order to achieve a well-founded knowledge about the principles of electrical engineering and control lab.

### OBJECTIVES:

To expose the students to the concepts of various types of electrical machines in the electrical engineering and control lab.

### Course Outcome:

| Course Outcome – Cos |                                                                                                                                                                | Cognitive Skill |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Analyse the regulation of DC generator by different methodologies                                                                                              | An              |
| CO-02                | Analyse performance the DC Motor                                                                                                                               | An              |
| CO-03                | Apply the different method to control the speed of DC motor                                                                                                    | A               |
| CO-04                | Analysis of control system stability using digital simulation and demonstrate the time domain and frequency domain analysis for linear time invariant systems. | U               |
| CO-05                | Design and implement 8051 microcontroller based systems and to Understand the concepts related to I/O and memory interfacing                                   | An              |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO \ CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|---------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01   | S    | L    | M    | M    | L    | M    | M    | M    | L    | S    | S    | L    |
| CO-02   | S    | S    | S    | L    | L    | M    | S    | S    | L    | S    | S    | L    |
| CO-03   | S    | S    | S    | M    | L    | S    | M    | M    | L    | S    | S    | L    |
| CO-04   | S    | S    | M    | L    | S    | M    | M    | S    | L    | S    | S    | L    |
| CO-05   | S    | S    | S    | L    | S    | M    | S    | S    | L    | S    | S    | L    |

S- Strong, M- Medium, L-Low, N- Not Relevant

1. OC and SC tests on single phase transformer (Predetermination of efficiency and regulation at given power factors)
2. Load test on 3-phase Induction motor (Determination of performance Characteristics)
3. Speed control of DC Shunt motor by
  - a) Armature Voltage control
  - b) Field flux control method
4. Load test on DC shunt motor.
5. Simulation of Non-linear system.
6. Simulation of stability analysis of linear system.

7. Communication between 8051 Microcontroller kit and PC.
8. Interfacing and Programming of Stepper Motor and DC Motor Speed control.
9. Programming using Arithmetic, Logical and Bit Manipulation instructions of 8051microcontroller.
10. Exercise in PLC: Frequency Response, Time Response, Sequence Response.

**TOTAL = 45 HOURS**

## SEMESTER IV

| SL. NO            | COURSE CODE | COURSE TITLE                          | L         | T        | P        | C         |
|-------------------|-------------|---------------------------------------|-----------|----------|----------|-----------|
| <b>THEORY</b>     |             |                                       |           |          |          |           |
| 1.                | MA3207      | Probability and Statistics            | 2         | 1        | 0        | 3         |
| 2.                | BS3201      | Environmental Studies                 | 2         | 0        | 0        | 2         |
| 3.                | ME3206      | Kinematics of Machinery               | 3         | 1        | 0        | 4         |
| 4.                | ME3207      | Manufacturing Processes-II            | 3         | 0        | 0        | 3         |
| 5.                | ME3208      | Strength of Materials                 | 3         | 0        | 0        | 3         |
| 6.                | ME3209      | Thermal Engineering                   | 3         | 0        | 0        | 3         |
| <b>PRACTICALS</b> |             |                                       |           |          |          |           |
| 7.                | ME3275      | Manufacturing Processes Laboratory-II | 0         | 0        | 2        | 1         |
| 8.                | ME3276      | Strength of Materials Laboratory      | 0         | 0        | 2        | 1         |
| 9.                | ME3277      | Thermal Engineering Laboratory-I      | 0         | 0        | 2        | 1         |
| <b>TOTAL</b>      |             |                                       | <b>16</b> | <b>2</b> | <b>6</b> | <b>21</b> |

|               |                                   |          |          |          |          |
|---------------|-----------------------------------|----------|----------|----------|----------|
| <b>MA3207</b> | <b>PROBABILITY AND STATISTICS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                   | <b>2</b> | <b>1</b> | <b>0</b> | <b>3</b> |

### Aim:

The probabilistic models are employed in countless applications in all areas of Science and Engineering. The course aim at providing necessary mathematical support and confidence to tackle real life problems.

### Objective:

To provide the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.

**Course Outcome:**

| <b>Course Outcomes</b><br>At the end of the course students should be able to |                                                                                                                                                                                                                                                                                                                                                                       | <b>Cognitive Skills</b> |
|-------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|
| CO-01                                                                         | Know the basic concepts of probability and random variables. Understand the characteristic of density random variable and continuous random variable. Able to compute mean, variance and generate moment generating functions. Understand the different distributions (ie) Binomial, Poisson, Uniform, Exponential, Gamma and Normal distribution and its properties. | R,U,A,An,<br>E, S       |
| CO-02                                                                         | Acquire skills in handling situations involving more than one random variable and functions of random variables. Understand the central tendency, correlation and correlation coefficient and also regression.                                                                                                                                                        | R,U,A,An,<br>E, S       |
| CO-03                                                                         | Apply t – test , F-test, Chi square test and large sample test by the transformation of hypothesis and analyze their conclusions using various level of significance.                                                                                                                                                                                                 | R,U,A,An,<br>E, S       |
| CO-04                                                                         | Apply various principles of analyzing the variance and also apply Monte Carlo simulation method to solve simultaneous problems                                                                                                                                                                                                                                        | R,U,A,An,<br>E, S       |
| CO-05                                                                         | Expose the basic characteristic features of quality control chart for mean, range, attributes, p chart and c chart.                                                                                                                                                                                                                                                   | R,U,A,An,<br>E, S       |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

**Mapping of Course Outcome with Programme Outcome**

| <b>PO</b><br><b>CO</b> | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-K | PO-L |
|------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| <b>CO-01</b>           | S    | S    | S    | M    | M    | S    | M    | S    | M    | M    | M    | M    |
| <b>CO-02</b>           | M    | S    | S    | M    | S    | S    | M    | S    | M    | M    | M    | M    |
| <b>CO-03</b>           | M    | S    | S    | M    | S    | S    | M    | S    | M    | M    | M    | M    |
| <b>CO-04</b>           | M    | S    | S    | S    | M    | S    | S    | S    | M    | M    | M    | M    |
| <b>CO-05</b>           | M    | M    | S    | S    | L    | S    | S    | S    | M    | L    | L    | L    |

S-Strong, M-Medium, L-Low, N-Not relevant

**UNIT I: Probability and Random variabl****9**

Axioms of Probability – Independent events – Conditional Probability – Random Variable – Probability mass function – Probability density function – Distribution function – Properties – Expectation – Binomial, Poisson, Uniform, Exponential and Normal distributions (Problems only).

**UNIT II: Two Dimensional Random Variables****9**

Joint distributions - Marginal and Conditional distributions –Expectation-Independence-Covariance – Correlation and Regression.

**UNIT III: Testing of Hypothesis****9**

Sampling distribution – Standard error – Sample size –Type I error and Type II error - One tailed and Two tailed tests – large sample tests- Proportions – means and difference of means – Small

sample tests – t-tests : Single mean, difference of means – F test for variances – Chi square test for independence of attributes and goodness of fit.

#### UNIT IV: Analysis of Variance and Simulation

9

Analysis of Variance- Principles of design of experiments - Completely randomized design Randomized block design and Latin Square Design. Discrete Event Simulation - Monte Carlo Simulation - Generation of Random Numbers using Congruent method (Simple Production Problems)

#### UNIT V: Statistical Quality Control

9

Quality Control –Chance causes and Assignable causes - Control charts for variables – Control chart for Mean ( $\bar{X}$ ) and Range (R). Control charts for Attributes, Proportion of defective (p chart), Number of defectives per unit (c chart).

**TOTAL: 30+15 = 45**

#### TEXT BOOKS

1. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, Eight Edition, Sultan Chand & Sons, 1996. Unit 1 ,2,3
2. Venkatraman M.K, “Numerical Methods” Fifth Edition, National Pub. Company, Chennai 2005 Unit 4, 5

| BS3201 | ENVIRONMENTAL STUDIES | L | T | P | C |
|--------|-----------------------|---|---|---|---|
|        |                       | 2 | 0 | 0 | 2 |

#### Aim:

To impart fundamental concepts and natural resources, eco systems, bio diversity

#### OBJECTIVES :

- To understand the basic concepts in environmental science
- To gain the knowledge about structure and natural cycles of environment.
- To get an idea about control methods of pollution.
- To know the information about conservation methods of forest and wild life.

#### Course Outcome:

| Course Outcome |                                                                                                                                                           | Cognitive Skill |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01          | Student will be able to demonstrate a general understanding of interdisciplinary nature of environmental uses and able to characterize natural resources. | U, A, An        |
| CO-02          | Students will be able to explain the effects of air, water, soil, noise and thermal pollution environment and suggest ways to reduce them.                | R, E ,A         |
| CO-03          | Students will be able to explain the effects of air, water, soil, noise and thermal pollution environment and suggest ways to reduce them.                | R, U, A         |
| CO-04          | Students will be able to understand the effects of human population and know about the awareness programme.                                               | R, A, E         |
| CO-05          | Students apply systems concept and methodologies to analyse and understand interaction between social and environmental process.                          | R, A, An        |

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

### Mapping of Course Outcome with Programme Outcome

| <b>PO</b><br><b>CO</b> | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-K | PO-L |
|------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| <b>CO-01</b>           | S    | M    | S    | M    | M    | S    | S    | S    | M    | S    | S    | M    |
| <b>CO-02</b>           | M    | M    | S    | M    | S    | S    | S    | S    | M    | S    | S    | M    |
| <b>CO-03</b>           | M    | M    | S    | M    | S    | S    | S    | S    | M    | S    | S    | M    |
| <b>CO-04</b>           | M    | M    | S    | S    | M    | S    | S    | S    | M    | S    | S    | M    |
| <b>CO-05</b>           | M    | M    | S    | S    | L    | S    | M    | S    | M    | S    | S    | L    |

S-Strong, M-Medium, L-Low, N-Not relevant

#### **UNIT I: NATURE OF ENVIRONMENT STUDIES AND NATURAL RESOURCES 9**

Environment studies- definition – scope and importance- need for public awareness-Methods to create environmental awareness- Natural resources- Forest resources- energy resources- food resources- water resources – land resources - mineral resources.

#### **UNIT II: ECO SYSTEMS AND BIO-DIVERSITY 9**

Concept and component of eco systems- producer, consumer, decomposer- structure and function of eco system- food chain and food web- energy flow model- aquatic eco system-forest eco system- desert eco system- pyramid of biomass- ocean eco system- grass land eco system- Bio diversity in India- value of bio diversity- biodiversity threatens- biodiversity protection- In-situ and Ex-situ conservation.

#### **UNIT III: ENVIRONMENTAL POLLUTION 9**

Meaning of environmental pollution- air pollution- acid rain – global warming- water pollution- water pollution control- soil pollution- urban waste and soil pollution- marine pollution- noise pollution- thermal pollution- solid and hazardous waste management- waste disposal methods- solid waste and India- natural disaster and disaster management.

#### **UNIT IV: HUMAN POPULATION AND ENVIRONMENT 9**

Population growth- distribution of population- factors affecting variation in population theories of population- future of human population- family welfare programme- HIV and AIDS- environment and human health- human rights- value education- women and child welfare.

#### **UNIT V: SOCIAL ISSUES AND THE ENVIRONMENT 9**

Unsustainable to sustainable development- sustainable development in India- water conservation, watershed management and water harvesting- environmental ethics- role of engineer in environmental protection.

**TOTAL: 45 HOURS**

**TEXT BOOKS**

1. Cunningham & saigo: 'Environmental science :A global concern' 4th Ed.W.c. Brown Publishers. USA. 1997 2.Chauhan A.S, 'Environmental studies' 2nd revised ed.2004, Jain Brother publishers, New Delhi

**REFERENCES:**

1. Benny Joseph : 'Environmental Science and Engineering', 2006, Tata McGraw- Hill Publication. 2. Siddique K.A. : Elements of Ecology and Environmental Pollution, 1st Ed. 2002, Kushal Publication, Varanasi. M

| ME3206 | KINEMATICS OF MACHINERY | L | T | P | C |
|--------|-------------------------|---|---|---|---|
|        |                         | 3 | 1 | 0 | 4 |

**AIM:**

To impart the fundamental knowledge of kinematics of machinery to the students in order to achieve a well-founded knowledge about the principles of kinematics of machinery.

**OBJECTIVES:**

- To understand the basic components and layout of linkages in the assembly of a system
- To understand the principles in analyzing the assembly with respect to the displacement,
- To understand the motion resulting from a specified set of linkages, design few linkages
- To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.

**Course Outcomes:**

| Course Outcome - COs |                                                             | Cognitive Skill |
|----------------------|-------------------------------------------------------------|-----------------|
| CO-01                | To be understand the basic concepts of kinematics of motion | R, U            |
| CO-02                | To be Analyze the kinematics of Linkages                    | An              |
| CO-03                | To be understand and analyze the cam mechanisms             | U, A            |
| CO-04                | To be understand and analyze the gears and gear trains      | U, A            |
| CO-05                | To be study and consist the friction in machine elements    | S               |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

**Mapping of Course Outcome with Programme Outcome**

| PO \ CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|---------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01   | S    | S    | S    | L    | L    | M    | S    | M    | M    | S    | S    | S    |
| CO-02   | S    | S    | S    | L    | L    | S    | S    | M    | M    | S    | S    | S    |
| CO-03   | S    | S    | S    | L    | L    | M    | S    | M    | M    | S    | S    | S    |
| CO-04   | S    | S    | S    | L    | L    | S    | S    | M    | M    | S    | S    | S    |
| CO-05   | M    | S    | S    | S    | L    | M    | M    | M    | L    | S    | L    | S    |

S- Strong, M- Medium, L-Low, N- Not Relevant

**UNIT I : BASICS OF MECHANISMS****9**

Terminology and definitions, degree of freedom, mobility. Grashoff's law. Kinematic inversions bar chain, slider crank chain. Mechanical advantage. Transmission angle. Description of common mechanisms, Introduction to 4-bar spatial mechanisms. Applications of mechanisms.

Kinematics: Displacement, velocity and acceleration analysis in simple mechanisms, graphical method, velocity and acceleration polygons. Kinematic analysis by algebraic method, a demonstration, vector approach, Chace equation, computer applications in the kinematics analysis of simple mechanisms.

**UNIT II: LINKAGES & STATIC FORCES****9**

Number and dimensional synthesis – two position synthesis of slider crank and four bar-mechanisms. Free Body diagram-conditions of equilibrium, two, three and four force members, effect of friction

**UNIT III: KINEMATICS OF CAM MECHANISMS****9**

Classification of cams and followers – Terminology and definitions – Displacement diagrams – Uniform velocity, parabolic, simple harmonic and cycloidal motions – Derivatives of follower motions – Layout of plate cam profiles – Specified contour cams – Circular arc and tangent cams – Pressure angle and undercutting – sizing of cams.

**UNIT IV: GEARS AND GEAR TRAINS****9**

Spur gear terminology and definitions. Fundamental law of toothed gearing and tooth forms. Interchangeable gears, gear tooth action-interference and undercutting. Helical, bevel, worm, rack and pinion gears (basics only). Gear trains, epicyclic gear trains, differentials, automotive transmission gear trains

**UNIT V: FRICTION IN MACHINE ELEMENTS****9**

Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Bearings and lubrication – Friction clutches – Belt and rope drives – Friction in brakes- Band and Block brakes.

**L.45+T. 15 =60 HOURS****TEXT BOOKS:**

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", 4<sup>th</sup> Edition, Oxford University Press, 2014.
2. Rattan, S.S, "Theory of Machines", 5<sup>th</sup> Edition, Tata McGraw-Hill, 2019.

**REFERENCES:**

1. Thomas Bevan, "Theory of Machines", 3<sup>rd</sup> Edition, CBS Publishers and Distributors, 2005.
2. Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2005
3. Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2009.
4. NPTEL courses: <http://nptel.iitm.ac.in/courses.php>, related web and video resources on Kinematics of Machines and Dynamics of Machines
5. Ghosh. A and Mallick, A.K., "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., New Delhi, 1988.
6. Theory of Machines by Abdulla Sheriff, DhanpatRai, New Delhi, 2006.
- 7.. Shigley J E and Uicker J J, "Theory of Machines and Mechanisms", McGraw -Hill Inc., New Delhi, 1996.
8. Sadhu Sigh : Theory of Machines, "Kinematics of Machine", Third Edition, Pearson Education, 2012

|               |                                     |          |          |          |          |
|---------------|-------------------------------------|----------|----------|----------|----------|
| <b>ME3207</b> | <b>MANUFACTURING PROCESSES – II</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                     | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**AIM:**

To impart the fundamental knowledge of manufacturing processes to the students in order to achieve a well-founded knowledge about the principles of manufacturing processes

**OBJECTIVES:**

To understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines

**Course Outcomes:**

| <b>Course Outcome - COs</b> |                                                                                                                                       | <b>Cognitive Skill</b> |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO-01                       | To understand the metal cutting processes, metal removal, types of chips, types of cutting tools.                                     | R,U,A                  |
| CO-02                       | To understand the lathe, drilling, shaper machine operations, work holding devices, machining time, cost estimation.                  | R,U,A                  |
| CO-03                       | To understand the milling machine, gear manufacturing processes, gear welding, gear shaping, spur, helical, bevel, worm gears,        | R,U,A                  |
| CO-04                       | To understand the abrasive processes, types of grinding processes, cylindrical, surface, centreless, broaching machines,              | R,U,A,                 |
| CO-05                       | To understand the non-traditional machining, ultrasonic, abrasive, laser beam, electron beam, micromachining, electron beam machining | R,U,A                  |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

**Mapping of Course Outcome with Programme Outcome**

| <b>PO</b><br><b>CO</b> | <b>PO-A</b> | <b>PO-B</b> | <b>PO-C</b> | <b>PO-D</b> | <b>PO-E</b> | <b>PO-F</b> | <b>PO-G</b> | <b>PO-H</b> | <b>PO-I</b> | <b>PO-J</b> | <b>PO-k</b> | <b>PO-L</b> |
|------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| <b>CO-01</b>           | S           | M           | L           | L           | M           | L           | L           | L           | M           | M           | L           | M           |
| <b>CO-02</b>           | M           | N           | M           | L           | N           | M           | L           | L           | S           | M           | L           | M           |
| <b>CO-03</b>           | S           | M           | L           | L           | N           | M           | L           | L           | L           | N           | M           | L           |
| <b>CO-04</b>           | S           | L           | M           | M           | N           | M           | M           | L           | N           | M           | M           | M           |
| <b>CO-05</b>           | S           | L           | N           | M           | N           | M           | L           | L           | M           | M           | M           | M           |

S- Strong, M- Medium, L-Low, N- Not Relevant

**UNIT I: THEORY OF METAL CUTTING**

**9**

Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, orthogonal metal cutting, thermal aspects, cutting tool materials, , tool wear, tool life, surface finish, cutting fluids and Machinability

**UNIT II: BASIC MACHINE TOOLS:**

**9**

Introduction to machine tools, lathe, shaper, planing, drilling and boring machines- working principle, operations, work holding devices, Calculation of machining time, cost estimation.

**UNIT III: MILLING, GEAR MANUFACTURING & BROACHING****9**

Milling Machine – Types, Nomenclature of Milling cutter, Application of milling machine - Gear manufacturing processes-gear welding, Gear shaping, manufacture of spur, helical, bevel, worm and worm wheel. Gear finishing. Broaching machines: broach construction – push, pull, surface and continuous broaching machines. Nomenclature of broaching tool.

**UNIT IV: ABRASIVE MACHINING AND RAPID PROTOTYPING****9**

Abrasive processes: grinding wheel – specifications and selection, types of grinding process–cylindrical grinding, surface grinding and centreless grinding Principles, silent features, advantages and applications of honing, lapping and super-finishing. Rapid Prototyping- Product development cycle, types of prototypes-principles and advantages, different types of additive manufacturing process viz 3D printing, stereo lithography, FDM and SLS.

**UNIT V: NON - TRADITIONAL MACHINING****9**

Need for non-traditional machining, ultrasonic machining, abrasive jet machining, laser beam machining, Micromachining. Electron beam machining, electric discharge machining, electric discharge wire cutting, electro chemical machining, electro chemical grinding, equipments, applications, advantages and limitations. Study of micro-electro manufacturing system (MEMS).

**TOTAL: 45 HOURS****TEXT BOOKS:**

1. Hajra Choudhury, "Elements of Workshop Technology", Vol.II., Media Promoters
2. Bhattacharya A, "New Technology", IE Publishing, New Delhi, 1984

**REFERENCES:**

1. Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J.White "Machine Tool Practices", Prentice Hall of India, 1998
2. HMT, "Production Technology", Tata McGraw Hill, 2001.
3. Geoffrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", McGraw Hill, 1984
4. Roy. A.Lindberg, "Process and Materials of Manufacture," Fourth Edition, PHI/Pearson Education 2006.
5. NPTEL courses, <http://www.nptel.iitm.ac.in/courses.php?disciplineId=112> web and video resources on Manufacturing Processes II by Prof. A.K. Chattopadhyay, Prof. A.B. Chattopadhyay, Prof. S. Paul.
6. B.H. Amstee, Philip F. Ostwald & Myron L. Begeman, "Manufacturing Processes", John Wiley & Sons, eighth edition.

| ME3208 | STRENGTH OF MATERIALS | L | T | P | C |
|--------|-----------------------|---|---|---|---|
|        |                       | 3 | 0 | 0 | 3 |

**AIM:**

To impart the fundamental knowledge of strength of materials to the students in order to achieve a well-founded knowledge about the principles of strength of materials

**OBJECTIVES:**

- To gain knowledge of simple stresses, strains and deformation in components due to external loads.
- To assess stresses and deformations through mathematical models of beams, twisting bars or combinations of both.
- Effect of component dimensions and shape on stresses and deformations are to be understood. The study would provide knowledge for use in the design courses.

**Course Outcomes:**

| Course Outcome - COs |                                                                                    | Cognitive Skill |
|----------------------|------------------------------------------------------------------------------------|-----------------|
| CO-01                | Students should able to understand the basic of stress, strain and various Loads.  | U               |
| CO-02                | Students should able to calculate (or) design the beam                             | A               |
| CO-03                | Students should able to understand the theory of torsion of shaft                  | U               |
| CO-04                | Students should able to calculate the B-M, slope and deflection by various methods | E               |
| CO-05                | Students should able to understand the principal strain pressure vessels           | R               |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

**Mapping of Course Outcome with Programme Outcome**

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | M    | M    | M    | M    | M    | M    | M    | M    | L    | M    |
| CO-02    | S    | S    | M    | M    | M    | M    | M    | M    | M    | M    | L    | M    |
| CO-03    | S    | S    | M    | M    | M    | M    | M    | M    | M    | M    | L    | M    |
| CO-04    | S    | S    | M    | M    | M    | M    | M    | M    | M    | M    | L    | M    |
| CO-05    | S    | M    | M    | M    | M    | M    | M    | M    | M    | M    | L    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

**UNIT I: STRESS & STRAIN****9**

Stress and strain due to axial force, elastic limit, Hooke's law-hysteresis-factor of safety - stresses in stepped bars, uniformly varying sections and composite bar due to axial force and temperature, Elastic Constant- Strain Energy due to axial force- proof resilience -stresses due to gradual load, sudden load and impact load.

**UNIT II: TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM****9**

Beams – types, transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and overhanging beams. Theory of simple bending, stress distribution, Load carrying capacity, Proportioning of sections. Flitched beams Shear stress distribution.

**UNIT III: TORSION OF CIRCULAR SHAFT****9**

Theory of torsion of shafts of circular, cross section. Assumptions, Derivation of torsion formulae, stresses strains and deformation in determinate and indeterminate shafts of hollow, solid, homogeneous and composite circular cross section subjected to twisting moments, stresses due to combine torsion, bending and axial force on shafts.

**UNIT IV: DEFLECTION OF BEAMS****9**

Relation between B.M., slope and deflection slope and deflection by double integration method (McCauley's method). Slope and Deflection in determinate beams by Moment Area method and conjugate beam method. Euler & Rankine Formula.

**UNIT V: PRINCIPAL STRESSES, PRINCIPAL STRAIN AND PRESSURE VESSELS****9**

Principal stresses and principal strain-Normal and shear stresses on any oblique planes and concept of principal planes and principal planes by analytical and graphical methods (Mohr's circle of stress 2-D). Stresses, strains and deformation in thin walled seamless cylindrical and spherical vessels due to internal fluid pressure. Change in volume, effects of additional compressible or Incompressible Fluid injected under pressure. Thick cylinders. Derivation of Lane's equation for stresses.

**TOTAL: 45HOURS****TEXT BOOKS:**

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2015
2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2007

**REFERENCES:**

1. Egor. P. Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2<sup>nd</sup> edition, 2015
2. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series
3. NPTEL courses, <http://nptel.iitm.ac.in/courses.php>, web and video courses on Strength of Materials by Prof. Sharma, S. C., and Prof. Harsha, S. P.

|               |                            |          |          |          |          |
|---------------|----------------------------|----------|----------|----------|----------|
| <b>ME3209</b> | <b>THERMAL ENGINEERING</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                            | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**AIM:**

To impart the fundamental knowledge of thermal engineering to the students in order to achieve a well-founded knowledge about the principles of thermal engineering

**OBJECTIVES :**

To apply the thermodynamic concepts into various thermal application like IC engines, Steam engines and Compressors.

**Course Outcomes:**

| Course Outcome - COs |                                                                                      | Cognitive Skill |
|----------------------|--------------------------------------------------------------------------------------|-----------------|
| CO-01                | Understanding the concepts of I.C engines and its various system involved            | R,U             |
| CO-02                | Evaluation of performance of I.C engines & how to control emissions from I.C engines | R,U, A, An, E   |
| CO-03                | Concept of various compressors and their performance evaluations                     | R,U, A, An, E   |
| CO-04                | Principles of various refrigerator ,AC systems and their performance estimation      | R,U, A, An, E   |
| CO-05                | Concept of Nozzle and turbines and their performance estimation                      | R,U, A, An, E   |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

**Mapping of Course Outcome with Programme Outcome**

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | S    | N    | N    | M    | N    | N    | N    | L    | M    | N    |
| CO-02    | S    | M    | S    | N    | M    | M    | N    | N    | L    | L    | M    | N    |
| CO-03    | S    | S    | S    | N    | N    | M    | N    | N    | N    | L    | M    | N    |
| CO-04    | S    | S    | S    | N    | N    | M    | N    | N    | N    | L    | M    | N    |
| CO-05    | S    | S    | S    | N    | N    | M    | N    | N    | N    | L    | M    | N    |

S- Strong, M- Medium, L-Low, N- Not Relevant

**UNIT I: IC ENGINES:****9**

S.I. Engines- Types of carburetors, Electronic fuel injection system, MPFI, GDI. Combustion in spark Ignition engines, abnormal combustion. Phenomenon of Detonation in SI engines

C.I. Engines- Fuel supply system, types of fuel pump, injector and Common rail fuel injection system. Combustion in compression ignition engines, Phenomenon of knocking in CI engine. Effect of knocking. Concepts of Supercharging and Turbo charging. Methods to determine power and efficiencies, heat balance sheet.

**UNIT II: COMPRESSORS****9**

Working principle and performance of single stage and multi stage reciprocating compressors-effect of clearance on volumetric efficiency, intercooling, equations for shaft work and efficiencies. Working principle of rotary compressors, screw compressors, scroll Compressors and Centrifugal Compressors.

**UNIT III: REFRIGERATION****9**

Refrigeration-. Refrigerants - types and properties, Methods of refrigeration-air refrigeration, Bell Coleman cycle, vapor compression refrigeration cycle, use of T-s diagrams, under-cooling and superheating. Performance calculations of air and vapour compression refrigeration systems. Study of absorption refrigeration system and comparison of various refrigeration cycles, cold storage and food processing plants study and design-Co<sub>2</sub> and ammonia refrigeration system.

**UNIT IV: AIR-CONDITIONING****9**

Air-Conditioning- Requirements for comfort and industrial air-conditioning, air washer, by-pass

factor, summer and winter air conditioning systems- design of various air conditioning system.

## UNIT V: STEAM NOZZLES AND TURBINES

9

Steam Nozzles - Effect of back pressure - condition for maximum discharge - effect of friction - supersaturated flow - impulse steam turbine - velocity diagrams - blade efficiency - stage efficiency - end thrust - reheat factor. Reaction steam turbine - degree of reaction - 50 % reaction turbine - influence of blade speed to steam speed - height of reaction blading - Method of compounding steam turbines. Governing of turbine.

**TOTAL: 45 HOURS**

### TEXT BOOKS:

1. Rajput. R. K., "Thermal Engineering" S.Chand Publishers , 8<sup>th</sup> edition 2010
2. Ballaney P.L., Thermal Engineering, 24th edition, Khanna Publishers, New Delhi, 2003.

### REFERENCES:

1. Ganesan V, "Internal Combustion Engine", Tata McGraw Hill Publishers Co. Ltd., New Delhi, 3<sup>rd</sup> edition 2008
2. Kothandaraman C P and Domkundwar S, "Thermodynamics and Thermal Engineering", DhanpatRai and Sons, New Delhi, 2004.
3. Arora.C.P, "Refrigeration and Air Conditioning", Tata McGraw-Hill Publishers 1994
4. Mathur M L, Sharma R P, "Internal Combustion Engines", DhanpatRai and Sons, Delhi, 1997.

|               |                                             |                      |                      |                      |                      |
|---------------|---------------------------------------------|----------------------|----------------------|----------------------|----------------------|
| <b>ME3275</b> | <b>MANUFACTURING PROCESS LABORATORY –II</b> | <b>L</b><br><b>0</b> | <b>T</b><br><b>0</b> | <b>P</b><br><b>2</b> | <b>C</b><br><b>1</b> |
|---------------|---------------------------------------------|----------------------|----------------------|----------------------|----------------------|

### AIM:

To impart the fundamental knowledge of manufacturing processes technology to the students in order to achieve a well-founded knowledge about the principles of manufacturing processes technology

### OBJECTIVES:

To Study and practice the various operations that can be performed shaper, drilling, milling machines etc. and to equip with the practical knowledge required in the core industries.

### Course Outcomes:

|       | <b>Course Outcome - COs</b>                                      | <b>Cognitive Skill</b> |
|-------|------------------------------------------------------------------|------------------------|
| CO-01 | Machining and Machining time estimations for Square Head Shaping | U,An                   |
| CO-02 | Contour milling using vertical milling machine                   | U,An                   |
| CO-03 | Spur gear cutting in milling machine                             | U,An                   |
| CO-04 | Gear generation in hobbing machine                               | A,An                   |
| CO-05 | Cylindrical grinding                                             | A,An                   |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | S    | L    | L    | M    | M    | M    | L    | S    | S    | L    |
| CO-02    | S    | S    | M    | L    | L    | M    | S    | S    | L    | S    | S    | L    |
| CO-03    | S    | S    | S    | L    | L    | M    | M    | M    | L    | S    | S    | L    |
| CO-04    | S    | S    | S    | L    | L    | M    | M    | S    | L    | S    | S    | L    |
| CO-05    | S    | S    | M    | L    | L    | M    | S    | S    | L    | S    | S    | L    |

S- Strong, M- Medium, L-Low, N- Not Relevant

### LIST OF EXPERIMENTS

1. Machining and Machining time estimations for Square Head Shaping
2. Machining and Machining time estimations for Hexagonal Head Shaping
3. Contour milling using vertical milling machine
4. Spur gear cutting in milling machine
5. Helical Gear Cutting in milling machine
6. Gear generation in hobbing machine
7. Plain Surface grinding
8. Cylindrical grinding
9. Tool angle grinding with tool and Cutter Grinder
10. Measurement of cutting forces in Milling / Turning Process

**TOTAL: 30 PERIODS**

|               |                                         |          |          |          |          |
|---------------|-----------------------------------------|----------|----------|----------|----------|
| <b>ME3276</b> | <b>STRENGTH OF MATERIALS LABORATORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                         | <b>0</b> | <b>0</b> | <b>2</b> | <b>1</b> |

### AIM:

To impart the fundamental knowledge of strength of mechanics materials to the students in order to achieve a well-founded knowledge about the principles of strength of mechanics materials

### OBJECTIVES :

- To impart practical training on simple machines like screw jack, worm wheel, etc.,
- To understand the theoretical and practical aspects of elasticity and plasticity of the materials through a variety of experiments.

**Course Outcomes:**

| Course Outcome - COs |                                                                                              | Cognitive Skill |
|----------------------|----------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Tension test on metals-stress strain characteristics, ductility, resilience, toughness.      | U,An            |
| CO-02                | Cupping test on metal sheets-load deformation characteristics, cupping load, cupping number. | U,An            |
| CO-03                | Hardness test on metals-Brinell, Vicker and Rockwell Hardness tests.                         | U,An            |
| CO-04                | Impact test on metals-Charpy, Izod impact tests.                                             | A,An            |
| CO-05                | Shear test on metals-direct shear strength, single shear, double shear.                      | A,An            |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

**Mapping of Course Outcome with Programme Outcome**

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | L    | M    | M    | L    | M    | M    | M    | L    | S    | S    | L    |
| CO-02    | S    | S    | S    | L    | L    | M    | S    | S    | L    | S    | S    | L    |
| CO-03    | S    | S    | S    | M    | L    | S    | M    | M    | L    | S    | S    | L    |
| CO-04    | S    | S    | M    | L    | S    | M    | M    | S    | L    | S    | S    | L    |
| CO-05    | S    | S    | S    | L    | S    | M    | S    | S    | L    | S    | S    | L    |

S- Strong, M- Medium, L-Low, N- Not Relevant

**LIST OF EXPERIMENTS**

1. Tension test on metals-stress strain characteristics, ductility, resilience, toughness.
2. Cupping test on metal sheets-load deformation characteristics, cupping load, cupping number.
3. Hardness test on metals-Brinell, Vicker and Rockwell Hardness tests.
4. Impact test on metals-Charpy, Izod impact tests.
5. Shear test on metals-direct shear strength, single shear, double shear.
6. Tests on helical springs-compression, tension springs-load deformation characteristics, stiffness, shear stress, modulus of rigidity, energy.
7. Torsion test on beams-torque and angle of twist characteristics, shear stress, modulus of rigidity, energy.
8. Tests on wood-tension, compression and bending-load deformation characteristics, Young's modulus, modulus of rupture.

**TOTAL: 30 PERIODS**

|        |                                  |   |   |   |   |
|--------|----------------------------------|---|---|---|---|
| ME3277 | THERMAL ENGINEERING LABORATORY-I | L | T | P | C |
|        |                                  | 0 | 0 | 2 | 1 |

**AIM:**

To impart the fundamental knowledge of thermal engineering to the students in order to achieve a well-founded knowledge about the principles of thermal engineering

## OBJECTIVES:

To study the components of I.C. engines, boilers, steam turbines and steam engines

## Course Outcomes:

| Course Outcome - COs |                                                                                                   | Cognitive Skill |
|----------------------|---------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Analyze the influence of variation in valve operation in 2S and 4S engines                        | R,U,A,An.E      |
| CO-02                | Calculate the performance Characteristic of I.C Engines                                           | R,U,A,An.E      |
| CO-03                | Calculate and compare the performance characteristics of Turbine, steam generator and compressors | R,U,A,An.E      |
| CO-04                | Calculate the IP,BP,BTE                                                                           | R,U,A,An.E      |
| CO-05                | Calculate and compare the performance characteristics                                             | R,U,A,An.E      |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

## Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | S    | S    | S    | M    | N    | M    | L    | L    | M    | L    |
| CO-02    | S    | S    | S    | S    | S    | M    | N    | M    | L    | L    | M    | M    |
| CO-03    | S    | S    | S    | S    | S    | M    | N    | M    | L    | L    | M    | M    |
| CO-04    | S    | S    | S    | S    | M    | L    | M    | S    | M    | M    | L    | M    |
| CO-05    | S    | S    | S    | S    | S    | M    | N    | M    | L    | L    | S    | S    |

S- Strong, M- Medium, L-Low, N- Not Relevant

## LIST OF EXPERIMENTS

1. Experimental study on valve timing diagram in 4-stroke engine cut model
2. Experimental study on port timing diagram in 2-stroke engine cut model
3. Performance test on constant speed 4-stroke diesel engine
4. Variable speed test on multi-cylinder diesel engine
5. Heat balance test on 4-stroke diesel engine
6. Performance test on constant speed single cylinder petrol engine
7. Performance test on high pressure two stage reciprocating air compressor
8. Performance testing of blower.
9. Energy Balance Test on a Steam Generator.
10. Performance test on Steam Turbine.
12. Visit to a industry/sugar factory for study of cogeneration plant

**TOTAL: 30 PERIODS**

### SEMESTER V

| SL. NO.          | COURSE CODE | COURSE TITLE                         | L         | T        | P        | C         |
|------------------|-------------|--------------------------------------|-----------|----------|----------|-----------|
| <b>THEORY</b>    |             |                                      |           |          |          |           |
| 1.               | MS3201      | Professional and Business Ethics     | 2         | 0        | 0        | 2         |
| 2.               | ME3202      | Engineering Materials and Metallurgy | 3         | 0        | 0        | 3         |
| 3.               | ME3211      | Dynamics of Machinery                | 3         | 1        | 0        | 4         |
| 4.               | ME3212      | Energy Conversion Technology         | 3         | 0        | 0        | 3         |
| 5.               | ME32XX      | Core Elective-I                      | 3         | 0        | 0        | 3         |
| 6.               | ME32XX      | Open Elective-I                      | 3         | 0        | 0        | 3         |
| <b>PRACTICAL</b> |             |                                      |           |          |          |           |
| 7.               | ME3279      | Dynamics of Machinery Laboratory     | 0         | 0        | 2        | 1         |
| 8.               | ME3280      | CAD / CAM Laboratory                 | 0         | 0        | 2        | 1         |
| 9.               | ME3281      | Metallurgy Laboratory                | 0         | 0        | 2        | 1         |
| <b>TOTAL</b>     |             |                                      | <b>17</b> | <b>1</b> | <b>6</b> | <b>21</b> |

|               |                                         |          |          |          |          |
|---------------|-----------------------------------------|----------|----------|----------|----------|
| <b>MS3201</b> | <b>PROFESSIONAL AND BUSINESS ETHICS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                         | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

#### **AIM:**

The course on Professional and Business Ethics is designed to cultivate ethical awareness and instill moral and social values in BE students. It aims to help students recognize legal and ethical issues in business decision-making, enhance analytical problem-solving skills, and foster ethical decision-making abilities. The course explores the relationship between ethics and business, examines moral and cultural values in the workplace, and encourages critical thinking and research on topics relevant to business ethics.

#### **COURSE OBJECTIVES:**

1. To Recognize legal and ethical issues in business decision-making.
2. To Understand and apply ethical rules and constraints.
3. To enhance analytical problem-solving skills and ethical decision-making abilities.

| Course Outcome - COs |                                                                                             | Cognitive Skill |
|----------------------|---------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Explore the relationship between ethics and business across different cultural traditions.  | R, U, An        |
| CO-02                | Explain the connection between ethics, morals, and values in the                            | U, An           |
| CO-03                | Formulate an ethical philosophy and relate it to current practices.                         | R, U, An        |
| CO-04                | Assess the ethical implications of business activities and competing demands on businesses. | U, An           |
| CO-05                | Critically analyse real-world contexts and conduct research projects on                     | R, U, An        |

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-K | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | M    | L    | L    | L    | L    | L    | L    | L    | S    | L    |
| CO-02    | S    | M    | M    | L    | L    | L    | L    | L    | L    | L    | S    | L    |
| CO-03    | S    | M    | M    | L    | L    | L    | L    | L    | L    | L    | S    | L    |
| CO-04    | S    | M    | L    | L    | L    | L    | L    | L    | L    | L    | S    | L    |
| CO-05    | S    | M    | L    | L    | L    | L    | L    | L    | L    | L    | S    | L    |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### Unit I: Human Values

9

Morals, Values, and Ethics -Integrity and Work Ethic - Service Learning and Civic Virtue - Respect for Others and Living Peacefully - Caring, Sharing, and Honesty - Courage, Valuing Time, and Co- operation - Commitment, Empathy, and Self-Confidence - Character and Spirituality

#### Unit II: Engineering Ethics

9

Senses of 'Engineering Ethics' and Moral Issues - Types of Inquiry and Moral Dilemmas - Moral Autonomy and Ethical Theories - Models of Professional Roles - Self-Interest, Customs, and Religion

#### Unit III: Engineering as Social Experimentation

9

Engineering as Experimentation - Engineers as Responsible Experimenters - Codes of Ethics and Legal Perspectives - Case Study: The Challenger Incident

#### Unit IV: Safety, Responsibilities, and Rights

9

Safety, Risk, and Risk Assessment - Risk-Benefit Analysis and Risk Reduction - Case Studies: Three Mile Island and Chernobyl - Collegiality, Loyalty, and Respect for Authority - Conflicts of Interest and Occupational Crime - Professional and Employee Rights - Intellectual Property Rights (IPR) and Discrimination

#### Unit V: Global Issues

9

Multinational Corporations and Environmental Ethics - Computer Ethics and Weapons Development - Engineers as Managers, Consultants, and Expert Witnesses - Sample Codes of Ethics from Professional Organizations

**Total: 45 hours**

**Textbooks:**

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering," McGraw-Hill, New York, Latest edition: 4th edition (2022).
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics," Prentice Hall of India, New Delhi, Latest edition: 2nd edition (2021).

**References:**

1. Charles D. Fleddermann, "Engineering Ethics," Pearson Education/Prentice Hall, New Jersey, Latest edition: 4th edition (2022).
2. Charles E Harris, Michael S. Protchard, and Michael J Rabins, "Engineering Ethics - Concepts and Cases," Wadsworth Thompson Learning, United States, Latest edition: 2nd edition (2023).
3. John R Boatright, "Ethics and the Conduct of Business," Pearson Education, New Delhi, Latest edition: 8th edition (2021).
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers," Oxford University Press, Oxford, Latest edition: 2nd edition (2022).

|               |                                             |          |          |          |          |
|---------------|---------------------------------------------|----------|----------|----------|----------|
| <b>ME3202</b> | <b>ENGINEERING MATERIALS AND METALLURGY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                             | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**AIM:**

To impart the fundamental knowledge of engineering materials and metallurgy to the students in order to achieve a well-founded knowledge about the principles of engineering materials.

**OBJECTIVE:**

To impart knowledge on the structure, properties, treatment, testing and applications of metals and non-metallic materials so as to identify and select suitable materials for various engineering applications.

**Course Outcomes:**

| <b>Course Outcome – Cos</b> |                                                                                                                      | <b>Cognitive Skill</b> |
|-----------------------------|----------------------------------------------------------------------------------------------------------------------|------------------------|
| CO-01                       | Able to gain the knowledge about Iron – Carbon system, various ferrous and nonferrous alloys                         | U                      |
| CO-02                       | Capable of knowing about different heat treatment process and its applications.                                      | A,R                    |
| CO-03                       | Study the knowledge about different types of non-metallic materials.                                                 | U                      |
| CO-04                       | Learn about different types of nano materials and its applications.                                                  | A                      |
| CO-05                       | Study and implements the different types of destructive and non destructive testing methods for different materials. | E                      |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | S    | M    | M    | M    | M    | M    | S    | M    | M    | M    |
| CO-02    | S    | S    | S    | M    | M    | M    | M    | M    | M    | M    | M    | M    |
| CO-03    | S    | S    | S    | M    | M    | M    | M    | M    | S    | L    | M    | M    |
| CO-04    | S    | S    | S    | M    | M    | M    | M    | M    | M    | M    | M    | M    |
| CO-05    | S    | S    | S    | M    | M    | M    | M    | M    | S    | M    | M    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### UNIT I: STEELS& ALLOYS

9

Allotropy, Iron - Iron carbide equilibrium diagram, critical temperatures. cooling curve and volume changes of pure iron. Effect of alloying additions on steel (Mn, Si, Cr, Mo, V Ti & W) - stainless and tool steels – HSLA. Gray, White malleable, spheroidal -Graphite - alloy cast-iron. Microstructures of slowly cooled steels, Estimation of carbon from Microstructures, non-equilibrium cooling of steels. Widmanstatten structures, Structures - property relationship.

Copper and Copper alloys, Aluminium and Aluminium alloys, Titatanium alloys, Magnesium alloys, Standards, precipitation strengthening treatment – Bearing alloys.

#### UNIT II: HEAT TREATMENT OF METALS

9

Heat treatment of steels, Transformation products of austenite, Time temperature Transformation diagrams(TTT), Critical cooling rate(CCR), continuous cooling transformation diagrams. Cooling media. Types - Annealing, normalizing, hardening. Tempering, Carburising, nitriding, carbonitriding, Flame and Induction hardening. Commercial heat treatment practice of gears of different sizes, tools, lathe beds, springs, etc.

#### UNIT II: POLYMERS, CERAMICS AND NANO MATERIALS

9

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET,PC, PA, ABS, PI, PAI,PPO, PPS, PEEK, PTFE, Polymers – Urea and Phenol formaldehydes)- Engineering Ceramics – Properties and applications of Al<sub>2</sub>O<sub>3</sub>, SiC, Si<sub>3</sub>N<sub>4</sub>, PSZ and SIALON.

Nano structured materials, Low-dimensional structures: Quantum wells, Quantum wires, and Quantum dots, Nano clusters & Nano crystals. Electronic and optical properties of nano crystallites, Metallic and semiconducting super lattices. Synthesis of nanostructured materials, Fabrication and characterization of nano electronic devices.Basics of synthesis and characterization of nano-multi-component systems for sensors (magnetic, electronic and optical) and electrodes.

**UNIT IV: POWDER METALLURGY AND COMPOSITES****9**

Powder metallurgy, Manufacturing Process, Compacting, Sintering, Vacuum processing. Properties of Powder processed materials, high energy compaction. Metal matrix composites, properties, Applications of Composites-Synthesis and fabrication of carbon nano structures for fuel cell and energy storage applications.

**UNIT V: MECHANICAL PROPERTIES AND TESTING****9**

Mechanical Properties And Testing: Mechanism of plastic deformation, slip and twinning. Types of fracture – Testing of materials under tension, compression and shear loads Hardness tests (Brinell, Vickers and Rockwell) Impact test, Izod and charpy, fatigue and creep test

Non Destructive Testing: basic principles and testing method for Radiographic testing, Ultrasonic testing, Magnetic particle inspection and Liquid penetrant inspections, Eddy current testing.

**TOTAL HOURS: 45****TEXTBOOK:**

1. Kenneth G. Budinski and Michael K. Budinski, “Engineering Materials”, Prentice Hall of India Private Limited, 4<sup>th</sup> Indian Reprint, 2002
2. Sydney H. Avner “Introduction to Physical Metallurgy” McGraw Hill Book Company, 2007.

**REFERENCES**

1. O.P. Khanna, *A text book of Materials Science and Metallurgy*, Khanna Publishers, 2003
2. William D Callister, “*Material Science and Engineering*”, John Wiley and Sons, 1997.
3. Raghavan V, “*Materials Science and Engineering*”, Prentice Hall of India Pvt. Ltd., 1999.
4. Dieter G. E., *Mechanical Metallurgy*, McGraw Hill Book Company, 1988
5. NPTEL courses, <http://www.nptel.iitm.ac.in/courses.php?disciplineId=112>: related web and video resources under *Mechanical Engineering & Metallurgy and Material Science* categorie.

| ME3211 | DYNAMICS OF MACHINERY | L | T | P | C |
|--------|-----------------------|---|---|---|---|
|        |                       | 3 | 1 | 0 | 4 |

**AIM:**

To study the principles of Dynamics of Machinery and various techniques which can be used for Mechanical Engineering.

**OBJECTIVE:**

- To understand the method of static force analysis and dynamic force analysis of mechanisms.
- To study the undesirable effects of unbalances in rotors and engines.

- To understand the concept of vibratory systems and their analysis.
- To understand the principles of governors and gyroscopes.

| Course Outcome - COs |                                                                                   | Cognitive Skill |
|----------------------|-----------------------------------------------------------------------------------|-----------------|
| CO-01                | Able to know the methods of static force and dynamic force analysis of mechanism. | R, U, An        |
| CO-02                | Capable of studying static and dynamic balancing of rotating masses               | U, An           |
| CO-03                | Learn the concept of free vibrations and their analysis                           | R, U, An        |
| CO-04                | Gain the knowledge of forced and torsional vibrations and their analysis          | U, An           |
| CO-05                | Able to study mechanisms for control                                              | R, U, An        |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | S    | M    | L    | M    | M    | M    | M    | M    | M    | M    |
| CO-02    | S    | S    | S    | M    | L    | M    | M    | M    | M    | M    | S    | M    |
| CO-03    | S    | S    | S    | M    | L    | M    | M    | M    | M    | M    | S    | M    |
| CO-04    | S    | S    | S    | M    | L    | M    | M    | M    | M    | M    | S    | M    |
| CO-05    | S    | S    | S    | M    | L    | M    | M    | M    | M    | M    | M    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

### UNIT I : DYNAMIC FORCE ANALYSIS & FLYWHEEL 9

Dynamic Force Analysis of Mechanism - Inertia force and D Alembert's principle. Dynamic force analysis of mechanisms including slider crank mechanism. Flywheel - Turning moment diagram-fluctuation of energy and speed, weight of flywheel required.

### UNIT II : BALANCING 9

Balancing of revolving, reciprocating masses in single plane and several planes-primary and secondary forces and couples, balancing of multicylinder inline engine. Balancing of V type of engines, direct and reverse crank technique. Partial Balancing In Locomotive Engines- Balancing Linkages. Balancing machines- field balancing, single and two planes.

### UNIT III : FREE VIBRATION 9

Basic features of vibratory systems-Basic elements and lumping of parameters, degrees of freedom, single degree of freedom system. Undamped free vibration-equation of motion, natural frequency. Damped free vibration, equation of motion, logarithmic decrement, critical speed of shaft, vibration measurements and control.

### UNIT IV : FORCED & TORSIONAL VIBRATION 9

Forced Vibration- Response to periodic forcing-forcing by unbalance, support motion, force and amplitude transmissibility, force transmissibility, vibration isolation, Vibration sensors. Torsional Vibration-Torsional vibration of two and three rotor systems, geared systems, critical speed, signature analysis, two degrees of freedom system.

**UNIT V : MECHANISMS FOR CONTROL****9**

Gyroscopes – effect of precession – motion on the stability of moving vehicles such as motorcycle – motorcar – aeroplanes and ships. Governors: Types of governors - Watt, Porter and Proell governors. Spring loaded governors –Hartnell and Hartung with auxiliary springs. Sensitiveness, isochronisms and hunting – stability – effort.

**TOTAL: 45 HOURS****TEXT BOOK:**

1. Ballaney P L, "Theory of Machines and Mechanisms", Khanna Publishers, New Delhi, 2005.
2. Thomas Bevan, "Theory of Machines", Edition: 3, CBS Publishers & Distributors, 2005.
3. S.S Rattan, "Theory of Machines", Edition: 4, Tata McGraw-Hill Publishing Company Ltd, 2017.

**REFERENCES:**

1. W.L Cleghorn, "Mechanisms of Machines", Edition: 2, Oxford University Press, 2005.
2. Derek Norfield, "Practical Balancing of Rotating Machinery", Elsevier International Projects Ltd, 2006.
3. Kameswara Rao N S V, "Mechanical Vibrations of Elastic Systems", Asian Books Pvt. Ltd., 2006.
4. NPTEL courses: <http://nptel.iitm.ac.in/courses.php>, related web and video resources on Kinematics of Machines and Dynamics of Machines.
5. A. Ghosh and A.K Mallick, "Theory of Mechanisms and Machines", Edition: 1, Affiliated East- West Pvt. Ltd, 2008
6. L. Robert Norton, "Kinematics and Dynamics of Machinery", Edition: 1, Tata Mc Graw Hill, 2009.

| ME3212 | ENERGY CONVERSION TECHNOLOGIES | L | T | P | C |
|--------|--------------------------------|---|---|---|---|
|        |                                | 3 | 0 | 0 | 3 |

**AIM:**

This course will introduce the students to most of the important aspects of Energy Conversion Technologies.

**OBJECTIVES:**

This will enable them to gain understanding of these devices and how these may be combined with other technologies, so as to arrive at optimal solutions for different applications.

| Course Outcome - COs |                                                                                                    | Cognitive Skill |
|----------------------|----------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Able to study the basic energy sources, types, working and performance of evaluation of boilers.   | R, U, An        |
| CO-02                | Gain the knowledge about various components and working of hydraulic and gas turbine power plants. | U, An           |
| CO-03                | Capable of studying the method of biomass, solar and wind energy conversion systems.               | R, U, An        |
| CO-04                | Learn the working of geothermal, tidal, OTEC and MHD power plants.                                 | U, An           |
| CO-05                | Enable to study types and working of nuclear power plant and also study economic and pollution.    | R, U, An        |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | S    | M    | S    | M    | M    | M    | M    | M    | M    | M    |
| CO-02    | S    | S    | S    | M    | S    | M    | M    | M    | M    | M    | S    | M    |
| CO-03    | S    | S    | S    | M    | S    | M    | M    | M    | M    | M    | S    | M    |
| CO-04    | S    | S    | S    | M    | S    | M    | M    | M    | M    | M    | S    | M    |
| CO-05    | S    | S    | S    | M    | S    | M    | M    | M    | M    | M    | M    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

### UNIT I: INTRODUCTION & THERMAL ENERGY SYSTEMS

9

Sources of energy - Boilers -Types, selection of boilers, combustion in boilers, performance evaluation, analysis of losses, feed water treatment, blow down. FBC Boilers: Introduction, mechanism of fluidized bed combustion, advantages, types of FBC boilers, operational features, draught system, draught losses, economizers, superheaters, preheaters.

### UNIT II: MECHANICAL ENERGY SYSTEMS & COGENERATION

9

Mechanical energy conversion, types, steam power plant, coal handling and ash handling, selection of site for a hydro-electric power plant- Classification, components and working of hydro- electric power plants and gas turbine power plants. Diesel electric power plant, combined cycle power plant and cogeneration.

### UNIT III: BIO MASS, SOLAR AND WIND ENERGY CONVERSION

9

Biomass conversion technologies (thermo chemical, biochemical and agrochemical) technology, briquetting, biomass gasification technology, biogas plant waste to energy conversion, bio fuels. Solar energy-PV cell, Flat plate and focusing collector, solar pond, Basic principles of wind energy conversion, site selection considerations, basic components, classification advantages and disadvantages of WECS (Wind Energy Conversion System), types, working and performance evaluation of wind turbine.

### UNIT IV: UNCONVENTIONAL AND DIRECT ENERGY TECHNOLOGIES

Introduction to geothermal energy, hydrothermal resources, geopressured resources, petrol thermal resources, applications of geothermal energy, basic principle of tidal power, components of tidal powerplant, site requirements, storage of tidal energy, advantages and

limitations of tidal power generation. Ocean Thermal Energy Cycle (OTEC) plant working. Thermoelectric converter -Thermionic converter – Magneto Hydra Dynamic system (MHD) - Electro gas dynamics (EGD) principles - types.

## **UNIT V: NUCLEAR ENERGY CONVERSION AND ECONOMICS OF POWER GENERATION**

**9**

General aspects of nuclear engineering, Fission and fusion, nuclear power generation, types of reactors- PWR-BWR- gas cooled reactors- heavy water reactors. utilization of waste heat and waste disposal, power plant economics & environmental considerations, pollution and its control.

**TOTAL: 45 HOURS**

### **TEXT BOOKS**

1. Culp A W, “Principles of Energy Conversion”, Tata McGraw Hill, 2000.
2. Reiner Decher, “Energy Conversion: Systems”, Flow Physics and Engineering, Oxford University Press, 1994.

### **REFERENCE BOOKS**

1. Thomas C. Elliot : ‘Hand book of power plant engineering’ McGraw Hill, 1989.
2. Stephen Fonash, Solar Cell Device Physics, Academic Press, Publication, 2010.
3. ManwellJ. F.,Mcgowan,J.G,Rogers A.L., Wind Energy Explained: Theory, Design and Application, John Wiley & Sons, ISBN:9780470015001, 2010.
4. H. Lee Willis and W.G. Scott: Distributed Power Generation: Planning and Evaluation, Marcel Dekker, 2000.
5. Garg H P., Prakash J., Solar Energy: Fundamentals & Applications, Tata McGraw Hill, New Delhi, 1997.
6. Nag.P.K. Power plant engineering: Tata McGraw-Hill.
7. R. Yadav, “Steam & Gas Turbines & Power Plant Engineering”, Central Publishing House, Allahabad.

| ME3279 | Dynamics of Machinery Laboratory | L | T | P | C |
|--------|----------------------------------|---|---|---|---|
|        |                                  | 0 | 0 | 2 | 1 |

### **AIM:**

To supplement the principles learnt in Dynamics of Machinery and understand how certain measuring devices are used for dynamic testing.

### **OBJECTIVE:**

To supplement the principles learnt in kinematics and Dynamics of Machinery. To understand how certain measuring devices are used for dynamic testing.

| Course Outcome - COs |                                                                                                             | Cognitive Skill |
|----------------------|-------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Determining the vibration and balancing.                                                                    | U,A             |
| CO-02                | Able to explain gear parameters, kinematics of mechanisms, gyroscopic effect and working of lab equipments. | U, A            |
| CO-03                | Capable of demonstrating the working principle of gyroscope and CAM.                                        | U, A            |
| CO-04                | Inspect the critical speed of shaft on the given load conditions.                                           | U, A            |
| CO-05                | Compute the moment of inertia of rigid bodies.                                                              | U, A            |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | S    | M    | M    | M    | L    | L    | L    | M    | M    | M    |
| CO-02    | S    | S    | S    | M    | M    | M    | M    | L    | M    | M    | L    | L    |
| CO-03    | S    | S    | S    | M    | M    | M    | M    | M    | M    | M    | M    | M    |
| CO-04    | S    | S    | S    | M    | M    | M    | L    | M    | M    | M    | M    | L    |
| CO-05    | S    | S    | S    | M    | M    | M    | M    | M    | L    | M    | M    | L    |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### LIST OF EXPERIMENTS:

- a). Balancing of rotating masses. (b) Balancing of reciprocating masses.
- Preparation of cam displacement curve and determination of jump speed of a cam.
- Determination of natural frequencies of transverse and torsional vibrations.
- Shaft alignment testing.
- Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.
- Determination of critical speed of shafts.
- Measurement of friction and wear.
- Determination of mass moment of Inertia of Fly wheel.
- Measurement of radius of gyration of compound pendulum
- Experimental verification of natural frequency of un-damped
- Whirling of shafts - Determination of critical speeds of shafts with concentrated loads.

**TOTAL: 30 Periods**

|        |                    |   |   |   |   |
|--------|--------------------|---|---|---|---|
| ME3280 | CAD/CAM LABORATORY | L | T | P | C |
|        |                    | 0 | 0 | 2 | 1 |

### COURSE OBJECTIVES

- 1 To gain practical experience in handling 2D drafting and 3D modelling software systems
- 2 Designing 3 Dimensional geometric model of parts, sub-assemblies, assemblies and exporting it to drawing
- 3 Programming G & M Code programming and simulate the CNC program and Generating part programming data through CAM software

| Course Outcome - COs |                                                                                                                                  | Cognitive Skill |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | To gain practical experience in handling 2D drafting and 3D modelling software systems                                           | U               |
| CO-02                | Developing good knowledge about Designing 3 Dimensional geometric model of parts, sub-assemblies, assemblies and exporting it to | U,A             |
| CO-03                | Capable of designing Surface modeling: Extrude, Sweep, Trim, Mesh of curves and Free form.                                       | A               |
| CO-04                | Studying the CNC Machining Centre                                                                                                | A               |
| CO-05                | Generate CL Data and Post process data using CAM packages for Machining and Turning Centre                                       | A,An            |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-l |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | S    | M    | L    | M    | M    | M    | M    | S    | S    | L    |
| CO-02    | S    | S    | S    | M    | L    | M    | S    | S    | M    | S    | S    | L    |
| CO-03    | S    | S    | S    | M    | L    | M    | M    | M    | M    | S    | S    | L    |
| CO-04    | S    | S    | S    | M    | L    | M    | M    | M    | M    | S    | S    | L    |
| CO-05    | S    | S    | S    | M    | L    | M    | S    | S    | M    | S    | S    | L    |

S- Strong, M- Medium, L-Low, N- Not Relevant

### LIST OF EXPERIMENTS

#### GEOMETRIC MODELLING (Introduction, 2D & 3D Design and Assembly)

- Study various configurations for CAD workstation and different peripherals.
- Demonstrate various Input/output devices and its connections and how to use it
- Demonstrate the procedure of loading the CAD software on a computer system.
- Prepare a 2D drawing using AutoCAD and 2D parametric sketcher environment.
- Prepare 3D solid models using AutoCAD (Three mechanical components)
- Prepare simple surface model using AutoCAD (Two mechanical components).
- Prepare 3D solid model using Creo (Three models that includes base features, Extrude/Protrude/Revolve).

- Prepare 3D solid models using Creo (Flange Coupling, Plummer Block, Screw Jack, Stuffing box, Connecting rod, Piston) Four models that includes engineering features.
- Bring actual industrial production drawings (single component) from nearby industry and distribute them among group of students for self study and interpretation. Ask students to practice these drawings using Creo software.
- Bring small real components like nuts, bolts, washers etc. in the class. Demonstrate various features of such components. Show the steps to create solid models of such parts using Creo software's.

#### MANUAL PART PROGRAMMING

##### 1. CNC Machining Centre

- Linear Cutting.
- Circular cutting.
- Cutter Radius Compensation.
- Canned Cycle Operations.

##### 2. CNC Turning Centre

- Straight, Taper and Radial Turning.
- Thread Cutting.
- Rough and Finish Turning Cycle.
- Drilling and Tapping Cycle.

##### 3. COMPUTER AIDED PART PROGRAMMING

- Generate CL Data and Post process data using CAM packages for Machining and Turning Centre.

**TOTAL: 30 PERIODS**

| ME3281 | METALLURGY LAB | L | T | P | C |
|--------|----------------|---|---|---|---|
|        |                | 0 | 0 | 2 | 1 |

#### AIM:

To impart the fundamental knowledge of metallurgy to the students in order to achieve a well- founded knowledge about the principles of metallurgy

#### OBJECTIVES:

- To gain practical experience with the processing, microstructure and performance of Materials.
- To gain practical experience with the relationships between them

| Course Outcome – Cos |                                                                                  | Cognitive Skill |
|----------------------|----------------------------------------------------------------------------------|-----------------|
| CO-01                | Gain a solid understanding of fundamental metallurgical principles and concepts. | U,A             |
| CO-02                | Capable of gaining the practical exposure about heat treatment.                  | U,A             |
| CO-03                | Enable to get exposure on usage of metallurgical microscope.                     | U,A             |
| CO-04                | Able to identify the different materials based on their microstructure.          | An              |
| CO-05                | Comprehend the properties and behavior of various metals and alloys.             | An              |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | M    | M    | M    | M    | L    | M    | L    | M    | L    | L    |
| CO-02    | S    | S    | M    | M    | M    | M    | L    | M    | M    | L    | M    | M    |
| CO-03    | S    | S    | S    | L    | M    | L    | L    | M    | M    | M    | M    | M    |
| CO-04    | S    | S    | S    | L    | M    | L    | L    | M    | M    | M    | M    | M    |
| CO-05    | S    | S    | S    | L    | M    | L    | L    | M    | M    | M    | M    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### List of Experiments

- Study of Metallurgical Microscope
- Identification of various engineering materials on the basis of density.
- Study of Preparation of a Specimen for metallographic examination
- Preparation of Mounted samples with the help of mounting press/cold setting resins.
- Study and drawing of microstructures of Steels.
- Study of effect of Annealing & Normalizing on properties of the steel Metallographic
- Determination of harden ability of steel by Jominy end Quench test
- To study various characteristics of copper powder and evaluate Green density as well as strength characteristics (hardness) of cold-compacted powder characterization.
- To Evaluate Green density as well as strength characteristics (Hardness) of sintered (conventional) compact powder characterization.

**TOTAL: 30 PERIODS**

## SEMESTER VI

| SL. NO.          | COURSE CODE | COURSE TITLE                                   | L  | T | P | C  |
|------------------|-------------|------------------------------------------------|----|---|---|----|
| <b>THEORY</b>    |             |                                                |    |   |   |    |
| 1.               | AI32D1      | Fundamentals of Artificial Intelligence        | 3  | 0 | 0 | 3  |
| 2.               | ME3213      | Mechanical Measurements & Metrology            | 3  | 0 | 0 | 3  |
| 3.               | ME3214      | Heat and Mass Transfer                         | 3  | 1 | 0 | 4  |
| 4.               | ME3215      | Design of Machine Elements                     | 3  | 1 | 0 | 4  |
| 5.               | ME32XX      | Core Elective - II                             | 3  | 0 | 0 | 3  |
| 6.               | ME32XX      | Core Elective - III                            | 3  | 0 | 0 | 3  |
| <b>PRACTICAL</b> |             |                                                |    |   |   |    |
| 7.               | ME3282      | Thermal Engineering Laboratory - II            | 0  | 0 | 2 | 1  |
| 8                | ME3283      | Mechanical Measurements & Metrology Laboratory | 0  | 0 | 2 | 1  |
| 9                | ME32P1      | Summer Internship                              | 0  | 0 | 2 | 1  |
| <b>TOTAL</b>     |             |                                                | 18 | 2 | 6 | 23 |

| AI32D1 | FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE | L | T | P | C |
|--------|-----------------------------------------|---|---|---|---|
|        |                                         | 3 | 0 | 0 | 3 |

### AIM:

To impart the fundamental knowledge of Artificial Intelligence to the students in order to achieve a well-founded knowledge and the principles

### OBJECTIVES:

- Understand the basic concepts of intelligent agents.
- Develop general-purpose problem-solving agents, logical reasoning agents, and agents that reason under uncertainty.
- Employ AI techniques to solve some of today's real world problems.

| <b>Course Outcome – COs</b>                          |                                                                                                                                                                         | <b>Cognitive Skill</b> |
|------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| At the end of the course students should be able to, |                                                                                                                                                                         |                        |
| CO-01                                                | Explain autonomous agents that make effective decisions in fully informed, partially observable, and adversarial settings.                                              | U                      |
| CO-02                                                | Choose appropriate algorithms for solving given AI problems                                                                                                             | A                      |
| CO-03                                                | Design and implement logical reasoning agents                                                                                                                           | R, A                   |
| CO-04                                                | Design and implement agents that can reason under uncertainty                                                                                                           | R, A                   |
| CO-05                                                | Understand the basic areas of artificial intelligence including problem solving, knowledge representation, reasoning, decision making, planning, perception and action. | U                      |

R-Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

### Mapping of Course Outcome with Programme Outcome

| <b>PO<br/>CO</b> | <b>PO-A</b> | <b>PO-B</b> | <b>PO-C</b> | <b>PO-D</b> | <b>PO-E</b> | <b>PO-F</b> | <b>PO-G</b> | <b>PO-H</b> | <b>PO-I</b> | <b>PO-J</b> | <b>PO-k</b> | <b>PO-L</b> |
|------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| <b>CO-01</b>     | S           | S           | M           | M           | M           | M           | L           | M           | L           | M           | L           | L           |
| <b>CO-02</b>     | S           | S           | M           | M           | M           | M           | L           | M           | M           | L           | M           | M           |
| <b>CO-03</b>     | S           | S           | S           | L           | M           | L           | L           | M           | M           | M           | M           | M           |
| <b>CO-04</b>     | S           | S           | S           | L           | M           | L           | L           | M           | M           | M           | M           | M           |
| <b>CO-05</b>     | S           | S           | S           | L           | M           | L           | L           | M           | M           | M           | M           | M           |

S-Strong, M-Medium, L-Low, N-Not relevant

### UNIT I: AI AGENTS

9

Introduction to AI – Agents and Environments – Concept of rationality – Nature of environments –Structure of agents – Problem solving agents–Search algorithms– Uninformed search strategies.

### UNIT II: PROBLEM SOLVING

9

Heuristic search strategies–heuristic functions - Local search and optimization problems – Local search in continuous space – Search with non-deterministic actions – Search in partially observable environments – Online search agents and unknown environments.

### UNIT III: THEORY OF GAME PLAYING

9

Game theory – Optimal decisions in games – Alpha-beta search – Monte-Carlo tree search –Stochastic games– Partially observable games.

Constraint Satisfaction Problems – Constraint propagation – Backtracking search for CSP – Local search for CSP– Structure of CSP.

**UNIT IV: KNOWLEDGE BASED LOGICAL AGENTS****9**

Knowledge-based agents – Propositional logic – Propositional theorem proving – Propositional model checking– Agents based on propositional logic.

First-order logic – Syntax and semantics – Knowledge representation and engineering – Inferences in first-order logic–Forward chaining– Backward chaining–Resolution.

**UNIT V: KNOWLEDGE REPRESENTATION****9**

Ontological engineering–Objects and categories–Events–Mental objects and Modal logic– Reasoning systems for categories – Reasoning with default information. Classicalplanning– Algorithmsforclassicalplanning–Heuristicsforplanning– Hierarchicalplanning–Non-deterministic domains–Time ,Schedule, and Resources–Analysis.

**TOTAL : 45 PERIODS****TEXT BOOKS**

1. Stuart Russel and Peter Norvig, “Artificial Intelligence: A Modern Approach”, Fourth Edition, Pearson Education,2020.

**REFERENCES**

1. DanW.Patterson,“IntroductiontoAIandES”,PearsonEducation,2007.
2. KevinNight,ElaineRich,andNairB.,“ArtificialIntelligence”,McGrawHill,2008.
3. Patrick H.Winston," Artificial Intelligence",Third edition, PearsonEdition,2006.
4. Deepak Khemani, “Artificial Intelligence”, Tata McGraw Hill Education, 2013.
- 5.Artificial Intelligence by Example: Develop machine intelligence from scratch using real artificial intelligence use cases –by Dennis Rothman,2018.

| ME3213 | MECHANICAL MEASUREMENTS AND METROLOGY | L | T | P | C |
|--------|---------------------------------------|---|---|---|---|
|        |                                       | 3 | 0 | 0 | 3 |

**AIM:**

Develop the student’s knowledge in various modes of measurement system and acquire proficiency in using, calibrating, designing precision instruments, and gauges.

**OBJECTIVE:**

- To understand the problems in the Measurement systems and develop the competency to resolve the problems.
- To understand the basic principles and applications of Engineering Mechanical Measurement science.
- To acquire proficiency in using, calibrating, designing precision instruments, gauges comparator, various measurement systems etc.

| Course Outcome - COs |                                                                                                  | Cognitive Skill |
|----------------------|--------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Able to study the basic methods of precision and accuracy.                                       | U               |
| CO-02                | Gain the knowledge of principle and application of pressure, strain and force measurement system | U,A             |
| CO-03                | Capable of learning basic principle and application of temperature measurement system.           | U,A             |
| CO-04                | Know the basic methods of linear angular and gear measurement.                                   | U               |
| CO-05                | Enable to study the basic methods of nano metrology and Microscope.                              | An              |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | S    | M    | M    | S    | M    | M    | M    | M    | L    | L    |
| CO-02    | S    | S    | S    | M    | M    | S    | M    | M    | M    | M    | L    | M    |
| CO-03    | S    | S    | S    | M    | M    | S    | M    | M    | M    | L    | M    | L    |
| CO-04    | S    | S    | S    | M    | M    | S    | M    | M    | M    | M    | M    | M    |
| CO-05    | S    | S    | S    | M    | M    | S    | M    | M    | M    | M    | M    | L    |

S- Strong, M- Medium, L-Low, N- Not Relevant

## UNIT I: INTRODUCTION TO METROLOGY

9

Methods of estimating accuracy and precision; Needs for accuracy and precision; Standards and their evolution; Types of errors in measurements. Limits, Fits and Tolerances, & Gauge Design- Basic concepts in limits, fits and tolerances Tolerance grades; ISO system of tolerance, Principles gauge design. Work Shop and Inspection gauges.

## UNIT II: PRESSURE, STRAIN AND FORCE MEASUREMENT

9

General configuration and functional element of measuring instrument, types of inputs, High pressure measuring instruments- Burden pressure gauge , diaphragm gauge, dead weight pressure tester and bellow gauge. Low pressure measuring instruments- Mcload gauge, Knudsen gauge, Ionization, thermal conductivity gauge, Strain measuring instruments: strain

gauges, types of strain gauges, strain gauge circuits temperature compensation selection and installation of strain gauge, use of strain gauges on rotating shafts, calibration and testing of above instruments. Force Measurement: Hydraulic, Pneumatic and Electrical methods of force measurement.

### **UNIT III: TEMPERATURE, LIQUID LEVEL, SPEED AND FLOW MEASUREMENT 9**

Temperature Measurement: Standards, various temperature measuring devices, bi-metallic strips, liquid in glass thermometer, pressure thermometer, thermocouple, electric resistance thermometer, Thermistor, radiation thermometer. Liquid Level Measurement: Various methods such as single float displacement or force transducers, pressure sensitivity bubbler or purge system, capacitance variation type, resistance variation type, radioisotopes. Speed Measurement: Tachometer and stroboscopes, Flow Measurement: Positive displacement flow meter, turbine meter, electromagnetic flow meter, Rota meter.

### **UNIT IV: LINEAR, ANGULAR AND GEAR MEASUREMENT 9**

Linear measuring instruments, precision measuring instruments, comparators. Angular measurement- Combination protractor, universal bevel protractor, sine bar, sine center, angle gauge block, clinometers, auto-collimator, angle decor, roller and cylindrical method, optical prism method. Screw thread measurement - Standard thread profiles, Different Thread Elements, Effective diameter, 2 wire and 3 wire methods as applied to standard and non-standard thread profiles, Best wire size, Virtual Effective Diameter. Gear measurement- Different types of gears, Basic elements of a gear, Involute function, Relations between different gear elements of spur and helical gears, Virtual number of teeth, Use of gear tooth Vernier for chordal and constant chordal measurements, Span measurement using Base Tangent Micrometers.

### **UNIT V : NANO METROLOGY 9**

Nanotechnology, Nano-dimension, Nanostructures, Importance of Nano-metrology, Introduction to Microscopy, Transmission Electron Microscope, Scanning Electron Microscope, Scanning Tunneling Microscope, Atomic Force Microscope, X-ray Diffraction System, XRD, Bragg Law, wo-dimensional XRD System, Applications.

**TOTAL: 45 HOURS**

**Text Book:**

1. Beckwith, Marangoni & Lienhard, "Mechanical measurements", Addison-Wesley, 5th edition, 2000. E.O.
2. Engineering Metrology R.K. Jain Khanna Publishers 2009.

**REFERENCES:**

1. S.Reganathan "Transducers Engineering", Allied publishers Limited, 1999.
2. ASTM Handbook of Industrial Metrology, prentice hall of India, ND.
3. Theory and Design for Mechanical Measurements, III edition Richard S Figliola, Donald E Beasley WILEY India Publishers.
4. Engineering Metrology, Gupta I.C, Dhanpat Rai Publications.
5. Measurement system, Ernest Deoblin's, Dhaneshmanick, McGraw-Hill.
6. Engineering Metrology and Measurements, N.V.Raghavendra and L. Krishnamurthy Oxford University Press, May 2013.

|               |                               |          |          |          |          |
|---------------|-------------------------------|----------|----------|----------|----------|
| <b>ME3214</b> | <b>HEAT AND MASS TRANSFER</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                               | <b>3</b> | <b>1</b> | <b>0</b> | <b>4</b> |

**AIM:**

Develop the student's knowledge in various modes of heat transfer, correlations in engineering calculations and the basic concepts of mass transfer.

**OBJECTIVE:**

- The course is intended to build up necessary background for understanding the physical behavior of various modes of heat transfer, like, conduction, convection and radiation.
- To understand the application of various experimental heat transfer correlations in engineering calculations.
- To learn the thermal analysis and sizing of heat changers.  
To understand the basic concepts of mass transfer.

| <b>Course Outcome - COs</b> |                                                                                                                                                | <b>Cognitive Skill</b> |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO-01                       | Able to learn concept of conduction heat transfer through plane wall, composite wall, cylinder, sphere and fins                                | R,U,A,E                |
| CO-02                       | Gain knowledge of convective heat transfer through flat plates, cylinders, vertical plates and pipes                                           | R,U,A,E                |
| CO-04                       | Enable to learn various laws of radiation heat transfer and to understand concepts of radiation heat transfer in black bodies and grey bodies. | R,U,A,E                |
| CO-05                       | Know the basic concepts of mass transfer                                                                                                       | R,U,A,An               |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-<br>A | PO-<br>B | PO-<br>C | PO-<br>D | PO-<br>E | PO-<br>F | PO-<br>G | PO-<br>H | PO-<br>I | PO-<br>J | PO-<br>k | PO-<br>L |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| CO-01    | S        | S        | S        | M        | M        | M        | L        | M        | M        | S        | S        | M        |
| CO-02    | S        | S        | S        | M        | M        | M        | L        | M        | M        | S        | S        | M        |
| CO-03    | S        | S        | S        | M        | M        | M        | L        | M        | M        | S        | S        | M        |
| CO-04    | S        | S        | S        | M        | M        | M        | L        | M        | M        | S        | S        | M        |
| CO-05    | S        | S        | S        | M        | M        | M        | L        | M        | M        | S        | S        | M        |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### UNIT I: CONDUCTION

9

Fundamental of conduction, Fourier's law of conduction, thermal conductivity - One dimensional steady state conduction through plane walls, composite wall, cylinder and composite coaxial cylinder, sphere and composite concentric sphere, system with variable thermal conductivity, thermal resistance, thermal contact resistant, and electrical analogy. Overall heat transfer coefficients, critical thickness or radius of insulation. Extended surface (fins): types of fins, Heat flow through rectangular fin, pin fin (Spine) of uniform cross-section, efficiency and effectiveness of fin.

#### UNIT II : CONVECTION

9

Convective Heat Transfer: fundamentals- continuity equation, momentum equation, energy equation, boundary layer concept, velocity boundary layer and thermal boundary layer and concept of turbulence. External flows forced convection heat transfer: use of empirical correlations for convective heat transfer-flat plates, cylinders and flow across tube of banks. Internal Flows- fully developed laminar flow in circular pipe. Free Convection- Development of Hydrodynamic and thermal boundary layer along a vertical flat plate - Use of empirical relations for vertical plates.

#### UNIT III : RADIATION

9

Emission characteristics and laws of black-body radiation, Irradiation total and monochromatic quantities, laws of Planck, Wien, Kirchhoff, Lambert, Stefan and Boltzmann, heat exchange between two black bodies, concepts of shape factor. Emissivity heat exchange between grey bodies radiation shields electrical analogy for radiation

#### UNIT IV : BOILING, CONDENSATION AND HEAT EXCHANGER

9

Boiling & Condensation: General aspects of boiling, boiling regimes, bubble growth, nucleate boiling, film boiling, boiling correlations, film wise & drop wise condensation, Laminar film condensation on vertical plate, turbulent film condensation, film condensation on tubes. Heat Exchangers: types of heat

exchangers, overall heat transfer coefficient and fouling factor. Concepts of LMTD and NTU methods- Problems using LMTD and NTU methods.

## **UNIT V : MASS TRANSFER**

**9**

Introduction- diffusion mass transfer: concentrations, velocities and fluxes, Fick's law, diffusion coefficient, steady state diffusion through a stagnant gas film, diffusion of water vapour through air. Convective mass transfer: convective mass transfer coefficient, governing equations, momentum, heat and mass transfer analogies, convective mass transfer correlations, energy exchange in evaporation of water into air.

**L: 45 + T: 15 = TOTAL: 60 HOURS**

### **TEXT BOOK:**

1. Sachdeva R.C., "Fundamentals of Engineering Heat and Mass Transfer", New Age International publication, (2017).
2. Kothandaraman C.P., "Fundamentals of Heat and Mass Transfer", New Age International, New Delhi, (2012).

### **REFERENCES:**

1. Incropera, F. P., DeWitt, D. P., Bergman, T. L., & Lavine.A. S, Fundamentals of Heat and Mass Transfer: John Wiley & Sons.
2. Ozisik, M. N, Heat transfer: a basic approach: McGraw-Hill.
3. Nag P.K., "Heat Transfer", Tata McGraw-Hill, New Delhi, (2014) .
4. Holman J.P., "Heat and Mass Transfer", Tata McGraw-Hill, (2013).
5. Donald Q. Kern, Process Heat Transfer, Tata McGraw Hill Publishing Company Ltd., New Delhi.

|               |                                   |          |          |          |          |
|---------------|-----------------------------------|----------|----------|----------|----------|
| <b>ME3215</b> | <b>DESIGN OF MACHINE ELEMENTS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                   | <b>3</b> | <b>1</b> | <b>0</b> | <b>4</b> |

### **AIM:**

To study the principles of design and various techniques which can be used for Mechanical Engineering.

### **OBJECTIVE:**

- To familiarize the various steps involved in the Design Process.
- To understand the principles involved in evaluating the shape and dimensions of a component

- To satisfy functional and strength requirements.
- To learn to use standard practices and standard data.
- To learn to use catalogues and standard machine components.

| Course Outcome - COs |                                                                                            | Cognitive Skill |
|----------------------|--------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Able to explain the influence of steady and variable stresses in machine component design. | U, An           |
| CO-02                | Gain the knowledge of concepts of design to shafts and couplings.                          | A, An           |
| CO-03                | Capable of applying the concepts of design to temporary and permanent joints.              | A, An           |
| CO-04                | Learn the concepts of design to energy-absorbing members, connecting rod, and crankshaft.  | A, An           |
| CO-05                | Studying the design to bearings and cutting tool elements.                                 | A, An           |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | S    | M    | M    | S    | M    | S    | S    | S    | S    | S    |
| CO-02    | S    | S    | S    | M    | M    | S    | M    | S    | S    | S    | S    | S    |
| CO-03    | S    | S    | S    | M    | M    | S    | S    | S    | S    | M    | S    | S    |
| CO-04    | S    | S    | S    | M    | M    | S    | M    | S    | S    | M    | S    | M    |
| CO-05    | S    | S    | S    | M    | M    | S    | S    | S    | S    | S    | S    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

**UNIT I : STEADY AND VARIABLE STRESSES IN MACHINE ELEMENTS 9**

Introduction to the design process - factor influencing machine design, selection of materials based on mechanical properties – Preferred numbers, fits and tolerances -Direct, Bending and torsional stress equations - Impact and shock loading - calculation of principle stresses for various load combinations, eccentric loading - Design of curved beams - crane hook and 'C' frame - Factor of safety - theories of failure - Stress concentration due to holes and notches – design for variable loading - Soderberg, Goodman and Gerber relations.

**UNIT II: DESIGN OF SHAFTS, COUPLINGS AND KEYS 9**

Design of solid and hollow shafts based on strength, rigidity and critical speed - Design of keys, key ways and splines - Design of crankshafts – Design of rigid and flexible couplings. Applications- Flange Coupling & Bushed pin type coupling

**UNIT III : DESIGN OF TEMPORARY AND PERMANENT JOINTS 9**

Introduction of screw threads in power screws – Types of threads -Threaded fasteners - Design of bolted joints including eccentric loading, Knuckle joints, Cotter joints - Design of welded joints, riveted joints for structures - Design of Piston and Connecting Rod.

**UNIT IV : DESIGN OF ENERGY STORING ELEMENTS 9**

Design of various types of springs, Design of helical springs - compression & tension springs – Leaf spring – Belleville spring- Design of flywheels considering stresses in rims and arms, for engines and machines

**UNIT V : DESIGN OF BEARINGS AND CUTTING TOOL ELEMENTS 9**

Sliding contact and selection of rolling contact bearings – Design of hydrodynamic journal bearings – McKee's Equation, Sommerfield Number, Life of bearing.Design of single point and multi point cutting tool.

**L: 45 + T: 15 = TOTAL: 60 HOURS**

**TEXT BOOK:**

1. Shigley's Mechanical Engineering Design Richard G. Budynas, and J. Keith Nisbett McGraw-Hill Education 10th edition, 2015.
2. Design of Machine Elements, V B Bhandari Tata McGraw Hill 4th Ed., 2016.
3. Design of Machine Elements-I Dr.M H Annaiah Dr. J Suresh Kumar Dr.C N Chandrappa New Age International (P) Ltd., 1s Ed., 2016.

## REFERENCES:

1. Ugural A.C, Mechanical Design: An Integral Approach, McGraw-Hill Book Co, 2004.
2. Spotts M.F., Shoup T.E, "Design and Machine Elements", Pearson Education, 2004.
3. Machine Design Hall, Holowenko, Laughlin (Schaum's Outline series) adapted by S.K.Somani Tata Mc Graw Hill Publishing Company Ltd Special Indian Edition, 2008.
4. Design of Machine Elements Volume I T. Krishna Rao IK international publishing house, New Delhi. 2012.
5. Elements of Machine Design H.G.Patil, S.C.Pilli, R.R.Malagi, M.S.Patil IK International First edition, 2019.

|        |                              |   |   |   |   |
|--------|------------------------------|---|---|---|---|
| ME3282 | THERMAL ENGINEERING LAB - II | L | T | P | C |
|        |                              | 0 | 0 | 2 | 1 |

### AIM:

- To study the heat transfer phenomena predict the relevant coefficient using implementation. To study the performance of refrigeration cycle / components.

### OBJECTIVE:

- To impart training to the students to conduct experiments on heat transfer equipment's in which the different modes of heat transfer occurs.
- To give training to conduct performance tests on heat exchangers
- To give hands-on training to conduct performance tests on refrigeration and Air- conditioning Plant.

| Course Outcome - COs |                                                                      | Cognitive Skill |
|----------------------|----------------------------------------------------------------------|-----------------|
| CO-01                | Able to evaluate the heat transfer coefficient by forced convection  | An,E            |
| CO-02                | Able to evaluate the heat transfer coefficient by natural convection | An              |
| CO-03                | Capable of knowing the performance of heat exchanger                 | R,U             |
| CO-04                | Calculate the performance of refrigerator , A/C, LPG.                | R,U             |
| CO-05                | Analyze the thermal conductivity of the metal rod.                   | An              |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-<br>A | PO-<br>B | PO-<br>C | PO-<br>D | PO-<br>E | PO-<br>F | PO-<br>G | PO-<br>H | PO-<br>I | PO-<br>J | PO-<br>k | PO-<br>L |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| CO-01    | S        | S        | S        | S        | S        | M        | M        | M        | M        | M        | S        | M        |
| CO-02    | S        | S        | S        | S        | S        | M        | M        | M        | M        | M        | S        | M        |
| CO-03    | S        | S        | S        | S        | S        | M        | M        | M        | M        | M        | S        | M        |
| CO-04    | S        | S        | S        | S        | S        | M        | M        | M        | M        | M        | S        | M        |
| CO-05    | S        | S        | S        | S        | S        | M        | M        | M        | M        | M        | S        | M        |

S- Strong, M- Medium, L-Low, N- Not Relevant

### LIST OF EXPERIMENTS:

1. Determination of heat transfer coefficient effectiveness and efficiency of pin fin.
2. Determination of the surface heat transfer coefficient for a vertical tube by natural convection.
3. Determination of the surface heat transfer coefficient for a horizontal pipe by forced convection.
4. Determination of Stefan-Boltzmann constant
5. Determination of emissivity of grey surface
6. Effectiveness of parallel /counter flow heat exchanger
7. Determination of thermal conductivity of the metal rod.
8. To determine the flash and fire point of the given fuel
9. To determine the viscosity of the given fuel
10. Determination of the coefficient of performance of the refrigeration tutor.
11. Determination of the performance of the air conditioning plant
12. Determination of the performance test in the LPG test rig.

13. Visit to Ice / Air conditioning plant to study the process and submission its report
14. Composite Slab Apparatus – Overall heat transfer co-efficient.
15. Heat transfer through lagged pipe.

**TOTAL: 16 HOURS**

|               |                                                             |          |          |          |          |
|---------------|-------------------------------------------------------------|----------|----------|----------|----------|
| <b>ME3283</b> | <b>MECHANICAL MEASUREMENTS AND METROLOGY<br/>LABORATORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                                             | <b>0</b> | <b>0</b> | <b>2</b> | <b>1</b> |

**AIM:**

- To provides the students an active learning environment for the measurement technologies used in Mechanical engineering field.

**OBJECTIVE:**

- To collect and analyse measurement data, evaluate measurement methodologies, and learn the capabilities and limitations of measurement technologies.
- To provide a hands-on experience in handling precision metrology instruments, their calibration.

| <b>Course Outcome - COs</b> |                                                                                                                                           | <b>Cognitive Skill</b> |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO-01                       | Able to Measure the gear tooth dimensions, angle using sinebar and other instruments.                                                     | A                      |
| CO-02                       | Capable of determining the various parameters like length, height, displacement, flatness using various instruments like vernier caliper, | A                      |
| CO-03                       | Know surface roughness using portable surface roughness tester and mechanical comparator.                                                 | E                      |
| CO-04                       | Demonstrate the use of instruments for measuring pressure , flow, speed, displacement and temperature.                                    | U,R                    |
| CO-05                       | Checking the limits of dimensional tolerances using comparators.                                                                          | An                     |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | S    | S    | M    | M    | L    | M    | M    | M    | M    | M    |
| CO-02    | S    | S    | S    | S    | M    | M    | M    | M    | M    | M    | M    | M    |
| CO-03    | S    | S    | S    | S    | M    | M    | N    | M    | M    | M    | M    | M    |
| CO-04    | S    | S    | S    | S    | M    | M    | M    | M    | M    | M    | M    | M    |
| CO-05    | S    | S    | S    | S    | M    | M    | N    | M    | M    | M    | M    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### LIST OF EXPERIMENTS:

1. Use of Floating carriage diameter measuring machine for measurement of screw thread characteristic dimensions such as major diameter, minor diameter and effective diameter.
2. Torsion test using Strain Gauges.
3. Cutting force measurement using Tool Dynamometer
4. Profile and Dimensional measurement on Tool Maker's microscope
5. Measurement of Displacement (Strain Gauge / LVDT / Wheatstone Bridge)
6. Measurement of Torque
7. Measurement of Vibration / Shock
8. Experiment using profile projector
9. Experiment to test roundness
10. Experiment on Autocollimator
11. Experiment on Acceptance sampling
12. Checking Dimensions of part using slip gauges
13. Measurement of Gear Tooth Thickness by Gear Tooth vernier caliper/Constant Chord /Span Micrometer

14. Measurement of Taper Angle using sine bar / tool makers microscope
15. Measurement of straightness and flatness
16. Measurement of thread parameters
17. Inspection of Production Job by statistical Process Control
18. Checking the limits of dimensional tolerances using comparators (Mechanical / Pneumatic / Electrical)

**TOTAL: 16 HOURS**

|               |                          |          |          |          |          |
|---------------|--------------------------|----------|----------|----------|----------|
| <b>ME32P1</b> | <b>SUMMER INTERNSHIP</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                          | <b>0</b> | <b>0</b> | <b>2</b> | <b>1</b> |

**AIM:**

- To gain and experience knowledge about practical experience in industries

**OBJECTIVE:**

- To provide hands on experience in industrial training programs.
- To introduce the knowledge about industrial equipment's.

| <b>Course Outcome - COs</b> |                                                                                                    | <b>Cognitive Skill</b> |
|-----------------------------|----------------------------------------------------------------------------------------------------|------------------------|
| CO-01                       | Gaining a better understanding of the engineering workplace                                        | U,An                   |
| CO-02                       | Developing and demonstrated workplace competencies necessary for professional and academic success | A                      |
| CO-03                       | Clarifying of career preferences and professional goals                                            | U,A                    |
| CO-04                       | Preparing a comprehensive project report after completing the work                                 | A                      |
| CO-05                       | Increasing competitiveness for full-time engineering employment                                    | A                      |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO     | PO-<br>A | PO-<br>B | PO-<br>C | PO-<br>D | PO-<br>E | PO-<br>F | PO-<br>G | PO-<br>H | PO-<br>I | PO-<br>J | PO-<br>k | PO-<br>L |
|--------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| <b>CO-01</b> | S        | S        | S        | S        | M        | M        | L        | M        | M        | M        | M        | M        |
| <b>CO-02</b> | S        | S        | S        | S        | M        | M        | M        | M        | M        | M        | M        | M        |
| <b>CO-03</b> | S        | S        | S        | S        | M        | M        | N        | M        | M        | M        | M        | M        |
| <b>CO-04</b> | S        | S        | S        | S        | M        | M        | M        | M        | M        | M        | M        | M        |
| <b>CO-05</b> | S        | S        | S        | S        | M        | M        | N        | M        | M        | M        | M        | M        |

The scope of this training is to undergo summer internship for at least 15 days in any of the industries, study the processes and operations submit the report of the training with the information about the product, process and the identified problems, along with the certificate and present before the review committee.

**Duration: 2- 3 week**

## SEMESTER VII

| SL. NO.          | COURSE CODE | COURSE TITLE                   | L         | T        | P        | C         |
|------------------|-------------|--------------------------------|-----------|----------|----------|-----------|
| <b>THEORY</b>    |             |                                |           |          |          |           |
| 1.               | MS3202      | Principles of Management       | 3         | 0        | 0        | 2         |
| 2.               | ME3216      | Design of Transmission System  | 2         | 1        | 0        | 3         |
| 3.               | ME32XX      | Core Elective-IV               | 3         | 0        | 0        | 3         |
| 4.               | ME32XX      | Core Elective-V                | 3         | 0        | 0        | 3         |
| 5.               | ME32XX      | Core Elective-VI               | 3         | 0        | 0        | 3         |
| 6.               | ME32XX      | Open Elective-III              | 3         | 0        | 0        | 3         |
| <b>PRACTICAL</b> |             |                                |           |          |          |           |
| 7.               | ME3284      | Simulation Laboratory          | 0         | 0        | 2        | 1         |
| 8.               | ME3285      | Mechatronics Laboratory        | 0         | 0        | 2        | 1         |
| 9.               | ME32P2      | Design and Fabrication Project | -         | -        | 2        | 1         |
| <b>TOTAL</b>     |             |                                | <b>17</b> | <b>1</b> | <b>6</b> | <b>20</b> |

|               |                                 |          |          |          |          |
|---------------|---------------------------------|----------|----------|----------|----------|
| <b>MS3202</b> | <b>PRINCIPLES OF MANAGEMENT</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                 | <b>3</b> | <b>0</b> | <b>0</b> | <b>2</b> |

### AIM

This course provides an introduction to the fundamental principles of management. It covers the essential concepts and practices involved in planning, organizing, leading, and controlling within an organizational context. The course is designed to equip engineering students with the management skills necessary to lead teams and projects effectively.

### Objectives

- To introduce students to the basic concepts and functions of management.
- To understand the role and responsibilities of managers in various organizational settings.
- To develop an understanding of the planning, organizing, leading, and controlling functions of management.
- To examine the impact of management theories and practices on organizational performance.
- To equip students with the skills necessary to manage people and processes effectively in a technical environment.

| Course Outcome - COs |                                                                                                    | Cognitive Skill |
|----------------------|----------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Define and explain the key concepts and functions of management.                                   | U,An            |
| CO-02                | Analyze the roles and responsibilities of managers in different organizational contexts.           | A               |
| CO-03                | Apply planning, organizing, leading, and controlling principles to real-world scenarios.           | U,A             |
| CO-04                | Evaluate the effectiveness of different management theories and practices.                         | A               |
| CO-05                | Demonstrate management skills necessary for leading teams and projects in a technical environment. | A               |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | S    | S    | M    | M    | L    | M    | M    | M    | M    | M    |
| CO-02    | S    | S    | S    | S    | M    | M    | M    | M    | M    | M    | M    | M    |
| CO-03    | S    | S    | S    | S    | M    | M    | N    | M    | M    | M    | M    | M    |
| CO-04    | S    | S    | S    | S    | M    | M    | M    | M    | M    | M    | M    | M    |
| CO-05    | S    | S    | S    | S    | M    | M    | N    | M    | M    | M    | M    | M    |

#### Unit I: Introduction to Management

7

Definition, nature, and importance of management - Functions of management: Planning, Organizing, Leading, Controlling - Roles and skills of managers - Evolution of management thought: Classical, Behavioral, and Modern theories - Scientific Management (Taylor) - Administrative Theory (Fayol) - Human Relations Movement (Mayo) - Contemporary approaches (Systems Theory, Contingency Theory)

#### Unit II: Planning

5

Nature and purpose of planning - Types of plans: Strategic, Tactical, Operational - Planning process and techniques - SWOT Analysis, SMART Goals, Scenario Planning - Decision making: Process, types, and tools- Rational Decision-Making Model - Bounded Rationality - Group Decision-Making Techniques (Brainstorming, Delphi Technique)

#### Unit III: Organizing

5

Organizational structure and design - Types of organizational structures: Functional, Divisional, Matrix, Network - Authority, responsibility, and delegation - Coordination and communication within organizations - Formal and Informal Communication Channels - Role of Technology in Organizational Communication (Emails, Video Conferencing, Collaborative Tools)

#### Unit IV: Leading

7

Leadership theories and styles - Trait Theory - Behavioral Theories (Ohio State Studies, Michigan Studies) - Contingency Theories (Fiedler's Model, Path-Goal Theory) - Transformational vs. Transactional Leadership - Motivation theories and practices, Maslow's Hierarchy of Needs, Herzberg's Two-Factor Theory, McClelland's Theory of Needs, Modern Approaches (Self-Determination Theory) -Group dynamics and team management - Stages of Team Development (Forming, Storming, Norming, Performing) - Managing Virtual Teams

**Unit V: Controlling****6**

Nature and purpose of control - Control process and techniques, Establishing Standards, Measuring Performance, Correcting Deviations - Types of control: Feed forward, Concurrent, Feedback - Quality control and management, Total Quality Management (TQM), Six Sigma, Lean Management, Use of Data Analytics in Quality Control

**Recommended Textbooks (Latest Editions)**

1. Robbins, S. P., Coulter, M., & DeCenzo, D. A. (2020). *Fundamentals of Management* (11th ed.). Pearson.
2. Griffin, R. W. (2022). *Management: Principles and Practices* (12th ed.). Cengage Learning.
3. Jones, G. R., & George, J. M. (2021). *Essentials of Contemporary Management* (9th ed.). McGraw-Hill Education.

**Reference Books (Latest Editions)**

1. Daft, R. L. (2021). *Management* (14th ed.). Cengage Learning.
2. Bateman, T. S., & Snell, S. A. (2020). *Management: Leading & Collaborating in a Competitive World* (14th ed.). McGraw-Hill Education.
3. Schermerhorn, J. R. (2021). *Management* (14th ed.). Wiley.
4. Hill, C. W. L., Schilling, M. A., & Jones, G. R. (2020). *Strategic Management: Theory & Cases* (13th ed.). Cengage Learning.
5. Kinicki, A., & Williams, B. K. (2021). *Management: A Practical Introduction* (10th ed.). McGraw-Hill Education.

**TOTAL: 30 HOURS**

|        |                                |   |   |   |   |
|--------|--------------------------------|---|---|---|---|
| ME3216 | DESIGN OF TRANSMISSION SYSTEMS | L | T | P | C |
|        |                                | 3 | 0 | 0 | 3 |

**AIM**

Develop the student's knowledge in design of transmission systems and to familiarize with latest Technologies

**OBJECTIVE**

- To develop competency in designing and selection of various types of mechanical transmission elements and systems.
  - To develop competency in designing a system involving the various transmission elements, as a design project in practical.
  - To learn to use standard data and catalogues
- (Use of P S G Design Data Book permitted)**

| Course Outcome - COs |                                                                              | Cognitive Skill |
|----------------------|------------------------------------------------------------------------------|-----------------|
| CO-01                | Apply the concepts of design and selection of belts, chains and rope drives. | R,U,A           |
| CO-02                | Apply the concepts of design to spur, helical gears.                         | R,U,A           |
| CO-03                | Apply the concepts of design to worm and bevel gears.                        | R,U,A           |
| CO-04                | Apply the concepts of design to gear boxes.                                  | R,U,A,<br>An    |
| CO-05                | Apply the concepts of design of cam, clutches and brakes.                    | R,U,A,<br>An    |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | S    | M    | M    | S    | M    | M    | M    | M    | M    | M    |
| CO-02    | S    | S    | S    | S    | M    | M    | L    | L    | M    | L    | M    | L    |
| CO-03    | S    | S    | S    | S    | M    | S    | M    | M    | L    | L    | M    | M    |
| CO-04    | S    | S    | S    | M    | M    | M    | M    | L    | L    | M    | M    | L    |
| CO-05    | S    | S    | S    | M    | M    | S    | L    | M    | L    | L    | M    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### UNIT I DESIGN OF FLEXIBLE ELEMENTS

9

Design of Flat belts - Selection of V belts and pulleys - Selection of hoisting wire ropes and pulleys - Design of Transmission chains and Sprockets.

#### UNIT II DESIGN OF SPUR AND HELICAL GEARS

9

Gear tooth profiles, Design of spur gears, force analysis, gear tooth failures, number of teeth, face width, beam strength of gear tooth, effective load on gear tooth, Design of helical gears, Virtual number of teeth, tooth proportions, force analysis, beam strength of helical gears, effective load on gear tooth, wear strength of helical gears.

#### UNIT III DESIGN OF WORM AND BEVEL GEARS

9

Design of worm gears, Worm gear geometry and nomenclature, Force and efficiency analysis, Bending and surface fatigue strength, Worm gear thermal considerations, Design approach for bevel gears- equivalent tooth.

#### UNIT IV DESIGN OF GEAR BOX

9

Gear Box: Standard Step ratio - Speed diagram - Kinematics layout - Design of multispeed Gear box, Actual speed calculation. Automatic gear box.

#### UNIT V CAMS, CLUTCHES AND BRAKES

9

Cam Design: Types-pressure angle and under cutting base circle determination-forces and surface stresses. Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-Electromagnetic clutches. Band and Block brakes - external shoe brakes – Internal expanding shoe brake.

**TOTAL: 60 HOURS**

**TEXT BOOKS:**

1. Bhandari V, "Design of Machine Elements", 4<sup>th</sup> Edition, Tata McGraw-Hill Book Co, 2016.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8<sup>th</sup> Edition, Tata McGraw-Hill, 2008.

**REFERENCES:**

1. Merhyle F. Spotts, Terry E. Shoup and Lee E. Hornberger, "Design of Machine Elements" 8<sup>th</sup> Edition, Printice Hall, 2003.
2. Orthwein W, "Machine Component Design", Jaico Publishing Co, 2003.
3. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.
4. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 4<sup>th</sup> Edition, Wiley, 2005
5. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.

|               |                              |          |          |          |          |
|---------------|------------------------------|----------|----------|----------|----------|
| <b>ME3284</b> | <b>SIMULATION LABORATORY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                              | <b>0</b> | <b>0</b> | <b>2</b> | <b>1</b> |

**AIM**

To study and simulate the working principle of air conditioning system, hydraulic and pneumatic cylinder and cam follower mechanism using MATLAB. Analyze the stresses and strains induced in plates, brackets and beams and heat transfer problems.

**OBJECTIVES**

To give exposure to software tools needed to analyze engineering problems.

To expose the students to different applications of simulation and analysis tools.

| <b>Course Outcome - COs</b> |                                                                                                              | <b>Cognitive Skill</b> |
|-----------------------------|--------------------------------------------------------------------------------------------------------------|------------------------|
| CO-01                       | Simulate the working principle of hydraulic and pneumatic cylinder and cam follower mechanisms using MATLAB. | An,A                   |
| CO-02                       | Analyze the stresses and strains induced in plates, brackets and beams and heat transfer problems.           | An,A                   |
| CO-03                       | Calculate the natural frequency and mode shape analysis of 2D components and beams.                          | An,A                   |
| CO-04                       | Vibration analysis of spring-mass systems..                                                                  | An,A                   |
| CO-05                       | Analyze the Harmonic, transient and spectrum analysis of simple system                                       | An,A                   |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-K | PO-L | PO-M |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | S    | M    | M    | S    | M    | M    | L    | S    | S    | M    |      |
| CO-02    | S    | S    | S    | M    | M    | M    | M    | M    | L    | S    | S    | S    |      |
| CO-03    | S    | S    | S    | M    | M    | S    | M    | M    | L    | S    | S    | M    |      |
| CO-04    | S    | S    | S    | M    | M    | S    | M    | M    | L    | S    | S    | M    |      |
| CO-05    | S    | S    | S    | M    | M    | M    | M    | M    | L    | S    | S    | S    |      |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### LIST OF EXPERIMENTS (MATLAB / FEM /ANSYS Software)

1. Force and Stress analysis using link elements in Trusses, cables etc
2. Stress and deflection analysis in beams with different support conditions.
3. Stress analysis of flat plates and simple shells.
4. Stress analysis of axi – symmetric components.
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress analysis of cylindrical shells.
7. Vibration analysis of spring-mass systems.
8. Model analysis of Beams.
9. Harmonic, transient and spectrum analysis of simple systems.
10. Mechanism Simulation using Multibody Dynamic software

TOTAL: 60 PERIODS

TOTAL: 30 HOURS

|        |                         |   |   |   |   |
|--------|-------------------------|---|---|---|---|
| ME3285 | MECHATRONICS LABORATORY | L | T | P | C |
|        |                         | 0 | 0 | 4 | 2 |

#### AIM:

To know the method of programming the microprocessor and also the design, modeling & analysis of basic electrical, hydraulic & pneumatic Systems which enable the students to understand the concept of mechatronics.

#### OBJECTIVE:

- To provide hands on experience to design and test the pneumatic circuit to perform basic control press, flow etc.
- To introduce the MAT Lab to simulate hydraulic, pneumatic and electrical circuit.

| Course Outcome - COs |                                                                                                                            | Cognitive Skill |
|----------------------|----------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Demonstrate the functioning of mechatronics system with various pneumatic, hydraulic and electrical systems.               | U,A             |
| CO-02                | Demonstrate the functioning of control systems with the help of PLC and microcontrollers.                                  | U,A             |
| CO-03                | Be able to integrate mechanical, electronics, control and computer engineering in the design of mechatronics systems.      | U,A             |
| CO-04                | Be able to do the complete design, building, interfacing and actuation of a mechatronic system for a set of specifications | U,A             |
| CO-05                | Be able to design of PLC and its applications, Circuit design of image processing technique                                | U,A             |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthes

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | S    | S    | M    | M    | M    | M    | M    | M    | M    | L    |
| CO-02    | S    | S    | S    | S    | M    | M    | M    | L    | M    | L    | M    | L    |
| CO-03    | S    | S    | S    | S    | S    | S    | M    | M    | M    | M    | M    | M    |
| CO-04    | S    | S    | S    | S    | S    | M    | M    | M    | M    | L    | M    | M    |
| CO-05    | S    | S    | S    | S    | M    | M    | M    | L    | M    | M    | M    | L    |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### LIST OF EXPERIMENTS

1. Assembly language programming of 8085 – Addition – Subtraction – Multiplication – Division – Sorting – Code Conversion.
2. Stepper motor interface.
3. Traffic light interface.
4. Speed control of DC motor.
5. Circuit design of various types of transducers.
6. Circuit design of hydraulic, pneumatic and electro-pneumatic circuits.
7. Modeling and analysis of basic hydraulic, pneumatic and electrical circuits using Software.
8. Circuit design of PLC and its applications.
9. Circuit design of image processing technique.

TOTAL: 45 HOURS

|        |                                |   |   |   |   |
|--------|--------------------------------|---|---|---|---|
| ME32P2 | DESIGN AND FABRICATION PROJECT | L | T | P | C |
|        |                                | 0 | 0 | 6 | 3 |

### AIM

Develop the student's capability to design and fabricate an Engineering model based on the knowledge gained.

### OBJECTIVES

The main objective is to give an opportunity to the student to get hands on training in the Fabrication of one or more components of a complete working model, which is designed by them.

| Course Outcome - COs |                                                                                                                                                  | Cognitive Skill |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. | An,A            |
| CO-02                | To train the students to face reviews and viva voce examination.                                                                                 | U,A             |
| CO-03                | Prepare a comprehensive project report after completing the work to the satisfaction of the supervisor by a group of 3 or 4 students.            | An,A            |
| CO-04                | Presenting the project work in national or international conference.                                                                             | U,A,An          |
| CO-05                | To gain inter personal skills.                                                                                                                   | U,A             |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

Strong, M- Medium, L-Low, N- Not Relevant

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-K | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | S    | S    | M    | S    | M    | M    | S    | M    | S    | L    |
| CO-02    | S    | S    | S    | S    | M    | S    | S    | S    | S    | S    | S    | L    |
| CO-03    | S    | S    | S    | S    | M    | S    | S    | S    | S    | S    | S    | L    |
| CO-04    | S    | S    | S    | S    | S    | S    | S    | S    | S    | S    | S    | L    |
| CO-05    | S    | S    | S    | S    | S    | S    | S    | S    | S    | S    | S    | L    |

### GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped into 2 to 4 and work under a project supervisor. The device / system / component(s) to be fabricated may be decided in consultation with the supervisor and, if possible, with an industry, that is preferably socially relevant. A project report to be submitted by the group and the fabricated model will be reviewed and evaluated for internal assessment by the

Committee constituted by the Head of the Department. At the end of the semester examination, the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

**TOTAL: 45 HOURS**

## SEMESTER VIII

| SL. NO.          | COURSE CODE | COURSE TITLE      | L | T | P  | C  |
|------------------|-------------|-------------------|---|---|----|----|
| <b>THEORY</b>    |             |                   |   |   |    |    |
| 1.               | ME32XX      | Core Elective-VII | 3 | 0 | 0  | 3  |
| 2.               | ME32XX      | Open Elective-IV  | 3 | 0 | 0  | 3  |
| <b>PRACTICAL</b> |             |                   |   |   |    |    |
| 3.               | ME32P5      | Project Work      | 0 | 0 | 16 | 8  |
| <b>TOTAL</b>     |             |                   | 6 | 0 | 16 | 14 |

|        |                     |          |          |          |          |
|--------|---------------------|----------|----------|----------|----------|
| ME32P5 | <b>PROJECT WORK</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|        |                     | 0        | 0        | 24       | 12       |

**AIM:**

Develop the student's knowledge by carrying out the project by identifying existing problem and to solve it.

**OBJECTIVES:**

The main Objective of the Project work is to develop the ability to solve a specific problem and also to train the students in preparing project reports.

| Course Outcome - COs |                                                                                                                                                  | Cognitive Skill |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. | An,A            |
| CO-02                | To train the students to face reviews and viva voce examination.                                                                                 | A               |
| CO-03                | Prepares a comprehensive project report after completing the work to the satisfaction of the supervisor by a group of 3 or 4 students.           | An,A            |
| CO-04                | Presenting project work in national or international conference.                                                                                 | A               |
| CO-05                | To gain inter personal relationship.                                                                                                             | A               |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-K | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | S    | S    | S    | M    | S    | M    | M    | S    | M    | S    | L    |
| CO-02    | S    | S    | S    | S    | M    | S    | S    | S    | S    | S    | S    | L    |
| CO-03    | S    | S    | S    | S    | M    | S    | S    | S    | S    | S    | S    | L    |
| CO-04    | S    | S    | S    | S    | S    | S    | S    | S    | S    | S    | S    | L    |
| CO-05    | S    | S    | S    | S    | S    | S    | S    | S    | S    | S    | S    | L    |

S- Strong, M- Medium, L-Low, N- Not Relevant

### GUIDELINE FOR REVIEW AND EVALUATION

To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports, to face reviews and viva voce examination. The students in a group of 3 to 4 work on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. Project work should be presented at a national or international conference. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

**TOTAL: 180 HOURS**

### CORE ELECTIVES

| SL. NO.       | COURSE CODE | COURSE TITLE                            | L | T | P | C |
|---------------|-------------|-----------------------------------------|---|---|---|---|
| <b>THEORY</b> |             |                                         |   |   |   |   |
| 1.            | ME32A1      | Artificial Intelligence and Robotics    | 3 | 0 | 0 | 3 |
| 2.            | ME32A2      | Industrial Robotics                     | 3 | 0 | 0 | 3 |
| 3.            | ME32A3      | Turbo Machinery                         | 3 | 0 | 0 | 3 |
| 4.            | ME32A4      | Welding Technology                      | 3 | 0 | 0 | 3 |
| 5.            | ME32A5      | Applied Hydraulics and Pneumatics       | 3 | 0 | 0 | 3 |
| 6.            | ME32A6      | Integrated Design & Manufacturing       | 3 | 0 | 0 | 3 |
| 7.            | ME32A7      | Non-Destructive Evaluation & Testing    | 3 | 0 | 0 | 3 |
| 8.            | ME32A8      | Mechanics of Composite Materials        | 3 | 0 | 0 | 3 |
| 9.            | ME32A9      | Machine Tool Technology                 | 3 | 0 | 0 | 3 |
| 10.           | ME32B1      | Nuclear Power Engineering               | 3 | 0 | 0 | 3 |
| 11.           | ME32B2      | Theory of Combustion And Emission       | 3 | 0 | 0 | 3 |
| 12.           | ME32B3      | Advanced Fluid Mechanics                | 3 | 0 | 0 | 3 |
| 13.           | ME32B4      | Advanced Engineering Thermodynamics     | 3 | 0 | 0 | 3 |
| 14.           | ME32B5      | Computational Fluid Dynamics            | 3 | 0 | 0 | 3 |
| 15.           | ME32B6      | Technology of Surface Coating           | 3 | 0 | 0 | 3 |
| 16.           | ME32B7      | Refrigeration and Air-Conditioning      | 3 | 0 | 0 | 3 |
| 17.           | ME32B8      | Lean Manufacturing                      | 3 | 0 | 0 | 3 |
| 18.           | ME32B9      | Design of Jigs, Fixtures and Press Tool | 3 | 0 | 0 | 3 |

|              |                                             |          |          |          |          |
|--------------|---------------------------------------------|----------|----------|----------|----------|
| <b>E32A1</b> | <b>ARTIFICIAL INTELLIGENCE AND ROBOTICS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|              |                                             | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**AIM:**

To introduce the concepts of artificial intelligence and robotics in manufacturing system.

**OBJECTIVE:**

- Gain a historical perspective of AI and its foundations.
- Learn the methods of solving problems using Artificial Intelligence.
- Introduce the concepts of Expert Systems and machine learning
- The graduates will have a sound foundation of the basic concepts associated with the design and functioning and application of Robots

| Course Outcome – Cos |                                                                                                                                                          | Cognitive Skill |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Identify problems that are enable to solution by AI methods.                                                                                             | R,U             |
| CO-02                | Identify appropriate AI methods to solve a given problem.                                                                                                | R,U             |
| CO-03                | Formalise a given problem in the language/framework of different AI methods and implement basic Algorithms.                                              | R,U             |
| CO-04                | Design and carry out an empirical evaluation of different algorithms on a problem formalization, and state the conclusions that the evaluation supports. | R,U             |
| CO-05                | Explain the concepts of industrial robots, classification, specifications and kinematics.                                                                | R,U             |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-02    | S    | S    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-03    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-04    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-05    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### UNIT I: INTRODUCTION OF AI

9

Introduction: AI problems, Intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, Structure of agents, Problem solving agents, Problem formulation.

#### UNIT II: PROBLEM SOLVING IN AI

9

Problem solving - State space search; Production systems, search space control: depth first, breadth-first search, heuristic search-Hill climbing, best-first search, branch and bound. Problem Reduction, Constraint Satisfaction End, Means-End Analysis

#### UNIT III: KNOWLEDGE REPRESENTATION IN AI

9

Knowledge Representation- Predicate Logic: Unification, modus ponens, resolution, dependency - directed backtracking. Rule based Systems: Forward reasoning; conflict resolution, backward reasoning; use of no backtrack. Structured Knowledge Representation: Semantic Nets: slots, exceptions and default frames, conceptual dependency, scripts.

**UNIT IV: HANDLING UNCERTAINTY AND LEARNING****9**

Handling uncertainty and learning-Non-Monotonic Reasoning, Probabilistic reasoning, use of certainty factors, fuzzy logic. Concept of learning, learning automation, genetic algorithm, learning by inductions, neural nets.

**UNIT V: ROBOTICS CONCEPT****9**

Robotics: Robot Classification, Robot Specification, notation; Direct and Inverse Kinematics: Co-ordinates Frames, Rotations, Homogeneous Coordinates, Arm Equation of four Axis SCARA Robot, TCV, Inverse Kinematics of Four Axis SCARA Robot.

**TOTAL: 45 HOURS****TEXT BOOKS:**

1. Stuart Russel, Peter Norvig, “Artificial Intelligence – A Modern Approach”, Pearson Education. 3<sup>rd</sup> Edition, 2009.

2. Robin R. Murphy, Introduction to AI Robotics, PHI Publication, 2000.

**REFERENCE BOOKS:**

1. E. Rich and K. Knight, “Artificial Intelligence”, Tata McGraw Hill, 3<sup>rd</sup> Edition, 2008.

2. Patterson, “Artificial Intelligence and Expert Systems”, PHI, 2<sup>nd</sup> Edition, 2009.

3. Giarrantana / Riley, “Expert Systems: Principles and Programming”, Thomson, 4<sup>th</sup> Edition, 2004.

4. Ivan Bratka, “PROLOG Programming for Artificial Intelligence, Pearson Education, 3<sup>rd</sup> Edition, 2000.

| ME32A2 | INDUSTRIAL ROBOTICS | L | T | P | C |
|--------|---------------------|---|---|---|---|
|        |                     | 3 | 0 | 0 | 3 |

**AIM:**

Develop the students knowledge about basic of robotics ,various components and programming of robotics.

**OBJECTIVE:**

- The graduates will have a sound foundation of a of basic terminologies and concept associated with Robotics
- To study kinematics and dynamics to understand the exact working patterns of robots.
- To study the associated knowledge and to observe the recent updates.

| Course Outcome - COs |                                                                                       | Cognitive Skill |
|----------------------|---------------------------------------------------------------------------------------|-----------------|
| CO-01                | Capable of having a good foundation of the basic principles and concepts of robotics. | R,U,            |
| CO-02                | Able to study the various drives and sensors of robot.                                | R,U,            |
| CO-03                | Able to learn about robot cell design and control.                                    | R,U,A           |
| CO-04                | To make the students to write the robot program.                                      | R,U,A,          |
| CO-05                | To study the artificial intelligence and plant automation.                            | R,U,A           |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-02    | S    | S    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-03    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-04    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-05    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### UNIT-I : FUNDAMENTAL CONCEPTS OF ROBOTICS: 9

History, Present status and future trends, robotics and automation, laws of robotics, robot definition, robotics systems and robot anatomy, specification of robots. resolution, repeatability and accuracy of a manipulator

#### UNIT-II : ROBOT DRIVES AND SENSORS: 9

Power transmission systems and control robot drive mechanisms, hydraulic-electric- pneumatic drives, mechanical transmission method - rotary-to-rotary motion conversion, rotary-to-linear Motion conversion, end effectors: types and gripping problems. Remote-centered - compliance. devicesandcontrolofactuatorsinroboticmechanisms.SensorsforRobots:- Characteristics of sensing devices, Selections of sensors, Classification and applications of sensors. Types of Sensors, Need for sensors and vision system in the working and control of a robot.

#### UNIT-III: ROBOT CELL DESIGN AND CONTROL: 9

Specifications of commercial robots-robot design and process specifications-motor selection in the design of robotic joint-robot cell layouts economic, safety and social aspects of robotics. Applications Of Robots: Capabilities of robots - robotics applications - obstacle avoidance-robotics in India - the future of robotics.

**UNIT-IV :****ROBOT PROGRAMMING****9**

Robot Programming : Methods of robot programming, lead through programming, motion interpolation, branching capabilities, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Introduction to various types such as RAIL and VALII etc, Features of each type and development of languages for recent robot systems.

**UNIT-V ARTIFICIAL INTELLIGENCE AND PLANT AUTOMATION****9**

Introduction, need for system Modeling, Building Mathematical Model of a manufacturing Plant, Modern Tools- Artificial neural networks in manufacturing automation, AI in manufacturing, Fuzzy decision and control, robots and application of robots for automation. Artificial Intelligence: - Introduction to Artificial Intelligence, AI techniques, Need and application of AI. Other Topics in Robotics: - Socio-Economic aspect of robotisation. Economical aspects for robot design, Safety for robot and associated mass, New Trends & recent updates in robotics.

**TOTAL: 45 HOURS****TEXT BOOKS:**

1. Mikell P. Groover et. Al., Industrial Robotics: Technology, Programming and Applications, McGraw – Hill International, 1986.
2. Ibrahim Zeid, “CAD/CAM Theory and Practice”, McGraw Hill, 2003.

**REFERENCE BOOKS:**

1. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotic Engineering - An Integrated Approach", Prentice Hall India, 2002.
2. Raymond A Higgins “Engineering Materials (Applied Physical Metallurgy) English Language book, society, 2003.
3. John J. Craig, “Introduction to Robotics: Mechanics and Control”, by Pearson India, ISBN: 9788131718360, 8131718360. Edition: 3rd Edition, 2008.

| ME32A3 | TURBO MACHINERY | L | T | P | C |
|--------|-----------------|---|---|---|---|
|        |                 | 3 | 0 | 0 | 3 |

**AIM:**

Make the students know about various turbo machines and their application.

**OBJECTIVE:**

To gain the fundamental knowledge about the design variations of thermal turbo machines and to perform the design of the thermal turbo machines.

| Course Outcome - COs |                                                                                     | Cognitive Skill |
|----------------------|-------------------------------------------------------------------------------------|-----------------|
| CO-01                | Able To learn about various fluid mechanics machines and their applications.        | R,U,A           |
| CO-02                | To gain the knowledge about types and applications of centrifugal fans and blowers. | R,U,A           |
| CO-03                | Capable of Learning about types and applications of centrifugal compressors.        | R,U,A,An        |
| CO-04                | To study about types and applications of axial flow compressors.                    | R,U,A,An        |
| CO-05                | Evaluate the performance of steam and gas turbines.                                 | R,U,A,An        |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-02    | S    | S    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-03    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-04    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-05    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### UNIT-I :

#### INTRODUCTION

9

Energy transfer between fluid and rotor, classification of fluid machinery, dimensionless parameters, specific speed, applications, stage velocity triangles, work and efficiency for compressors and turbines.

#### UNIT-II:

#### CENTRIFUGAL FANS AND BLOWERS

9

Centrifugal fans and blowers: Types, stage and design parameters. Flow analysis in impeller blades, volute and diffusers. Losses, characteristics curves and selection criteria. Fan drives and fan noise.

#### UNIT-III:

#### CENTRIFUGAL COMPRESSORS

9

Centrifugal Compressors: Construction details, types, impeller flow losses, slip factor, diffuser analysis. Losses and performance curves.

#### UNIT-IV:

#### AXIAL FLOW COMPRESSORS

9

Axial flow compressors: Stage velocity triangles, enthalpy-entropy diagrams, stage losses and efficiency, work done Factor, simple stage design problems, and performance characteristics..

**UNIT-V:****STEAM AND GAS TURBINES****9**

Construction and working principle - impulse and reaction turbines, performance calculations, Gas turbine; Brayton cycle and multi-staging - Power and efficiency calculations.

**TOTAL: 45 HOURS****TEXT BOOKS:**

1. Dixon, S.L., Fluid Mechanics and Thermodynamics of Turbo machines, 5<sup>th</sup> Edition., Butterworth Heinemann, 2005.
2. Sayers, A.T., Hydraulic and Compressible Flow Turbo machines, CBLS, 2003.

**REFERENCE BOOKS:**

1. Ganesan, V., Gas Turbines, 2<sup>nd</sup> Edition., Tata McGraw-Hill, 2003.
2. Lakshminarayana, B., Fluid Dynamics and Heat Transfer of Turbo machinery, Wiley Inter science, 2006.

| ME32A4 | WELDING TECHNOLOGY | L | T | P | C |
|--------|--------------------|---|---|---|---|
|        |                    | 3 | 0 | 0 | 3 |

**AIM:**

Learn about various welding process and its industrial applications.

**OBJECTIVE:**

- Students will demonstrate an appropriate attitude and behavior related to welding technology.
- The graduates will have a sound foundation of occupational safety issues including the avoidance of physical hazards in the work environment

| Course Outcome - COs |                                                                                                                                                                         | Cognitive Skill |
|----------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO -01               | Able to Study the working principles, equipment, and applications of special welding processes.                                                                         | R,U             |
| CO -02               | To know about working, equipment's and applications of unconventional welding process. To study about working ,equipment's and applications of special welding process. | R,U             |
| CO -03               | To learn about industrial-oriented applications of welding processes.                                                                                                   | R,U             |
| CO -04               | Capable Of studying about welding metallurgy and design of welding.                                                                                                     | R,U             |
| CO -05               | To study various quality control (QC) testing methods of weldments.                                                                                                     | R,U             |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-<br>A | PO-<br>B | PO-<br>C | PO-<br>D | PO-<br>E | PO-<br>F | PO-<br>G | PO-<br>H | PO-<br>I | PO-<br>J | PO-<br>k | PO-<br>L |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| CO-01    | S        | M        | M        | L        | N        | M        | L        | L        | M        | M        | M        | M        |
| CO-02    | S        | S        | M        | L        | N        | M        | L        | L        | M        | M        | M        | M        |
| CO-03    | S        | S        | M        | L        | N        | S        | L        | L        | M        | M        | L        | M        |
| CO-04    | S        | S        | M        | L        | N        | S        | L        | L        | M        | M        | L        | M        |
| CO-05    | S        | M        | M        | L        | N        | M        | L        | L        | M        | M        | M        | M        |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### UNIT-I: **SPECIAL WELDING PROCESSES:** 9

Power sources, equipment's and accessories, application, limitation and other characteristics of: (a) Gas tungsten arc (TIG) welding (b) Gas metal arc (MIG) welding (c) Submerged arc welding (d) Electro slag welding processes. Resistance welding processes-principle-Types (spot, seam, projection, percussion, flash), Equipment required for each application.

#### UNIT-II : **UNCONVENTIONAL WELDING PROCESSES** 9

Electron beam welding, Laser beam welding, Plasma arc welding, Friction welding, friction stir welding, Explosive welding, Ultrasonic welding, Stud welding, under water welding, Diffusion bonding, Cold welding, Welding of dissimilar metals.

#### UNIT-III: **WELDING APPLICATION TECHNOLOGY** 9

Heat exchangers, power cycle piping, super heaters, reheaters, economizer, auxiliary pipes-materials, processes and testing /inspection, Use of automatic welding and systems in automobile industry, Oil and gas industry-materials, processes, fabrication, inspection and testing. Case studies based on recent trends and development.

#### UNIT-IV : **WELDING METALLURGY AND DESIGN** 9

Physical metallurgy of welding, various zones in weldments, Effect of temperature on metals, Metallurgical defects associated with welding process – causes and remedies. Design of weldments- Welding symbols and standards (National and international), positions of welding joint and groove design. Weld stress Calculations Design of weld size.

#### UNIT-V : **WELDMENT TESTING** 9

Defects in welding in various processes-Causes and remedies; Destructive testing of weldments, Strength, hardness, ductility, fatigue, creep properties etc. Nondestructive testing of weldments; Ultrasonic dye penetrant, magnetic particle inspection. X ray testing procedures and identification of defects case studies. Weld thermal cycle Residual stressed distortion in welding stress relieving techniques.

**TOTAL: 45 HOURS**

#### TEXT BOOKS:

1. "Welding Principles and Applications" by Larry Jeffus: 8th Edition 2016
2. "Welding: Principles and Practices" by Edward R. Bohnart: 5th Edition 2018

**REFERENCE BOOKS:**

1. "Welding Metallurgy" by Sindo Kou: 2nd Edition (2002)
2. "Welding Metallurgy" by Sindo Kou 2nd Edition (2002)

|               |                                          |          |          |          |          |
|---------------|------------------------------------------|----------|----------|----------|----------|
| <b>ME32A5</b> | <b>APPLIED HYDRAULICS AND PNEUMATICS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                          | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**AIM:**

To know the advantages and applications of Fluid Power Engineering and Power Transmission Systems.

**OBJECTIVE:**

- To learn the fundamentals of hydraulic and pneumatic systems and components.
- To learn the applications of fluid power systems in the automation of machine tools and other equipment.
- To learn about different hydraulic circuits and systems.
- To learn the different pneumatic circuits and systems.

| <b>Course Outcome - COs</b> |                                                                                                     | <b>Cognitive Skill</b> |
|-----------------------------|-----------------------------------------------------------------------------------------------------|------------------------|
| CO-01                       | Able to explain the Fluid power and operation of different types of pumps.                          | R,U,A                  |
| CO-02                       | Summarize the features and functions of hydraulic motors, actuators, and flow control valves.       | R,U,A                  |
| CO-03                       | Capable of explaining the different types of hydraulic circuits and systems..                       | R,U,A,An               |
| CO-04                       | Explain the working of different pneumatic circuits and systems.                                    | R,U,A,                 |
| CO-05                       | Summarize the various trouble shooting methods and applications of hydraulic and pneumatic systems. | R,U,A,                 |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

**Mapping of Course Outcome with Programme Outcome**

| <b>PO<br/>CO</b> | <b>PO-A</b> | <b>PO-B</b> | <b>PO-C</b> | <b>PO-D</b> | <b>PO-E</b> | <b>PO-F</b> | <b>PO-G</b> | <b>PO-H</b> | <b>PO-I</b> | <b>PO-J</b> | <b>PO-k</b> | <b>PO-L</b> |
|------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| <b>CO-01</b>     | S           | M           | M           | L           | N           | M           | L           | L           | M           | M           | M           | M           |
| <b>CO-02</b>     | S           | S           | M           | L           | N           | M           | L           | L           | M           | M           | M           | M           |
| <b>CO-03</b>     | S           | S           | M           | L           | N           | S           | L           | L           | M           | M           | L           | M           |
| <b>CO-04</b>     | S           | S           | M           | L           | N           | S           | L           | L           | M           | M           | L           | M           |
| <b>CO-05</b>     | S           | M           | M           | L           | N           | M           | L           | L           | M           | M           | M           | M           |

S- Strong, M- Medium, L-Low, N- Not Relevant

**UNITI: FLUID POWER SYSTEMS AND FUNDAMENTALS 9**

Introduction to fluid power, advantages of fluid power, application of fluid power systems. Types of fluids and fluid power systems, properties of hydraulic fluids, fluid power symbols. Basics of hydraulics, applications of Pascal's Law. Laminar and turbulent flow, Reynolds number, Darcy's equation. Losses in pipes, valves, and fittings, simple problems.

**UNITII: HYDRAULIC SYSTEM & COMPONENTS 9**

Sources of Hydraulic Power: Pumping theory Pump classification Gear pump, Vane Pump, piston pump, construction and working of pumps pump performance Variable displacement pumps. Fluid Power Actuators: Linear hydraulic actuators Types of hydraulic cylinders, Single acting, Double acting special cylinders like tandem, Rod less, Telescopic, Cushioning mechanism, Construction of double acting cylinder, Rotary, Semi rotary actuators Fluid motors, Gear, Vane and Piston motors.

**UNITIII: HYDRAULIC CIRCUITS 9**

Construction of Control Components: Directional control valve, 3/2-way valve, 4/2-way valve, Shuttle valve, check valve, pressure control valve, pressure reducing valve, sequence valve, flow control valve (fixed and adjustable), electrical control solenoid valves, relays, ladder diagram. Accumulators: Types, circuits, sizing of accumulators. Intensifier applications and intensifier circuit.

**UNITIV: PNEUMATIC SYSTEMS AND COMPONENTS 9**

Pneumatic Components: Properties of air Compressors Filter, Regulator, and Lubricator Unit Air control valves, Quick exhaust valves, Pneumatic actuators. Fluid Power Circuit Design, Speed control circuits, synchronizing circuit, Penumo hydraulic circuit, Sequential circuit design for simple applications using cascade method.

**UNITV: PNEUMATIC CIRCUITS 9**

Servo systems Hydro Mechanical servo systems , Electro hydraulic servo systems and Proportional valves. Introduction to Electro Hydraulic Pneumatic logic circuits, ladder diagrams, PLC applications in fluid power control. Fluid power circuits failure and troubleshooting.

**Fluid Logic Control Systems-** Introduction – Principles of Fluid logic control --- Basic Fluid Devices-- fluidic elements – Fluidic sensors-- MPL control systems- MPL control of Fluid power circuits-- Basic concepts of PLC.

**TOTAL: 45 HOURS**

**TEXT BOOKS:**

1. Anthony “Esposito, Fluid Power with applications”, Prentice Hall international, 2008.
2. R. Srinivasan “Hydraulic and Pneumatic Controls” 2<sup>nd</sup> Edition ,Tata McGraw - Hill Education 2008.

## REFERENCE BOOKS:

1. John Pippenger, Tyler “Hicks, Industrial Hydraulics”, McGraw Hill International Edition, 2011.
2. Andrew Parr, “Hydraulics and pneumatics”, Jaico Publishing House, 2003.
3. FESTO, “Fundamentals of Pneumatics”, Vol I, II, III.
4. Majumdar S.R, “Pneumatic systems-principles and maintenance”, Tata McGraw Hill 2000.
5. Werner Deppert, “Kurt Stoll, Pneumatic Application”, Vogel verlag–2000.
- Majumdar.S.R, “Oil Hydraulics”, Tata McGraw Hill, 2002.

|        |                                  |   |   |   |   |
|--------|----------------------------------|---|---|---|---|
| ME32A6 | INTEGRATED DESIGN& MANUFACTURING | L | T | P | C |
|        |                                  | 3 | 0 | 0 | 3 |

### AIM:

To bring new possibilities in design and the manufacturing cycle through innovative parameters and designs.

### OBJECTIVE:

The course provides the basic concepts of product design, product features, and its architecture so that students can have a fundamental understanding of the common features a product has and how to incorporate them suitably.

- To study process management and improvement.
- To learn the concept of product development management.
- To study the basic concepts of project planning.

| Course Outcome - COs |                                                                                   | Cognitive Skill |
|----------------------|-----------------------------------------------------------------------------------|-----------------|
| CO-01                | Able to study the integration of customer requirements in product design.         | R,U,A           |
| CO-02                | Apply a structural approach to ethical issues and team management.                | R,U,A           |
| CO-03                | Capable of providing students with the knowledge of product architecture.         | R,U,A ,An       |
| CO-04                | Students gain the knowledge of industrial design.                                 | R,U,A,An        |
| CO-05                | Able to provide students with the design for manufacturing & product development. | R,U,A,An        |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-<br>A | PO-<br>B | PO-<br>C | PO-<br>D | PO-<br>E | PO-<br>F | PO-<br>G | PO-<br>H | PO-<br>I | PO-<br>J | PO-<br>k | PO-<br>L |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| CO-01    | S        | M        | M        | L        | N        | M        | L        | L        | M        | M        | M        | M        |
| CO-02    | S        | S        | M        | L        | N        | M        | L        | L        | M        | M        | M        | M        |
| CO-03    | S        | S        | M        | L        | N        | S        | L        | L        | M        | M        | L        | M        |
| CO-04    | S        | S        | M        | L        | N        | S        | L        | L        | M        | M        | L        | M        |
| CO-05    | S        | M        | M        | L        | N        | M        | L        | L        | M        | M        | M        | M        |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### UNIT I : INTRODUCTION 9

Need for IPPD Strategic importance of product development integration of customer designer materials supplier and process planner. Competitor and customer behavior analysis. Understanding customer promoting customer understanding involve customer in Development and managing requirements - Organization process management and improvement. Plan and establish product specifications.

#### UNIT II: ETHICAL ISSUES AND TEAM MANAGEMENT 9

Ethical Issues and Team Management: Ethical issues considered during Engineering design process, Product liability, Tort law, functioning, discharge, Team Dynamics and problem solving tools in design, Case studies.

#### UNIT III: PRODUCT ARCHITECTURE 9

Implications-Product change Variety component standardization-product performance-manufacturability-product development management-establishing the architecture creation clustering-geometric layout development fundamental and incidental interactions related system level design issues secondary systems architecture of the chunks-creating detailed inter face specifications.

#### UNIT IV: INDUSTRIAL DESIGN 9

Integrate process design-managing costs Robust design, QFD-Integrating CAD, CAM, CAE, PDM, MPM tools-FMEA/FMECA and SPCTechniques for process yield enhancement-simulating product performance and manufacturing processes electronically need for industrial design-impact-design process-investigation of customer needs conceptualization-refinement management of the industrial design process technology driven products user-driven products assessing the quality of industrial design concept of total product engineering.

**UNIT V: DESIGN FOR MANUFACTURING & PRODUCT DEVELOPMENT 9**

Definition-Estimation of manufacturing cost reducing the component costs and assembly costs minimize system complexity-prototype basics principles of prototyping planning for prototypes economic analysis understanding and representing tasks-baseline project planning-accelerating the project-project execution Collaborative CAD, Virtual Reality Goals, Augmented Reality, Animation and Simulation.

**TOTAL: 45 HOURS**

**TEXT BOOK:**

1. George E Dieter, "Engineering Design" 3<sup>rd</sup> Edition, , McGraw Hill, 2001.
2. Kevin N. Otto, Kristin L. Wood, "Product Design", Pearson Education, 2004.
3. Gahl, W Beitz J Feldhusun, K. G. Grote, "Engineering Design", 3<sup>rd</sup> Edition, Springer 2007.
4. W. Ernest Eder, S. Hosendl., "Design Engineering", CRC Press, 2008.
5. Ali K. Kamrani and Emad Abouel Nasr, "Engineering Design and Rapid Prototyping", Springer, 2010.

| ME32A7 | NON-DESTRUCTIVE EVALUATION&TESTING | L | T | P | C |
|--------|------------------------------------|---|---|---|---|
|        |                                    | 3 | 0 | 0 | 3 |

**AIM:**

To impart knowledge on Non Destructive Testing procedures.

**OBJECTIVE:**

- To learn the fundamentals of Non-Destructive Evaluation & Testing.
- To learn the working and operation of non-destructive testing equipment and evaluation.

| Course Outcome - COs |                                                                                                               | Cognitive Skill |
|----------------------|---------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Able to operate advanced Non-Destructive Testing (NDT) instruments and equipment easily.                      | R,U,A           |
| CO-02                | They will be able to demonstrate Safety procedures for operating NDT equipment should be followed diligently. | R,U,A           |
| CO-03                | Students can be able to study ultrasonic testing and acoustic emission                                        | R,U,A ,An       |
| CO-04                | They will exploit the advantages of NDT in industrial applications for the benefit of the society             | R,U,            |
| CO-05                | Students are Capable of gain the knowledge of eddy current methods.                                           | R,U,A,An        |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-02    | S    | S    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-03    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-04    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-05    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### UNIT I: 9 **INTRODUCTION**

Introduction: Visual methods: Optical aids, In-situ metallography, Optical holographic methods, Dynamic inspection. Penetrant flaw detection: Principles: Process: Penetrant systems: Liquid penetrant materials: Emulsifiers: cleaners' developers: sensitivity: Advantages: Limitations: Applications.

#### UNIT II: 9 **RADIOGRAPHIC METHODS**

Radiographic methods and Limitations: Principles of radiography: sources of radiation, Ionising radiation - X-rays sources, gama-rays sources Recording of radiation: Radiographic sensitivity: Fluoroscopic methods: special techniques: Radiation safety.

#### UNIT III: 9 **ULTRASONIC TESTING AND ACOUSTIC EMISSION**

Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique – Principle, AE parameters, Application.

#### UNIT IV: 9 **MAGNETIC METHODS**

Magnetic methods: Advantages, Limitations, Methods of generating fields: magnetic particles and suspending liquids Magnetography, field sensitive probes: applications. Measurement of metal properties. Electrical methods:

#### UNIT V: 9 **EDDY CURRENT METHODS**

Eddy current methods: potential-drop methods, applications. Electromagnetic testing: Magnetism: Magnetic domains: Magnetization curves: Magnetic Hysteresis: Hysteresis-loop tests: comparator - bridge tests Absolute single coil system: applications. Other methods: Acoustic Emission methods, Acoustic methods: Leak detection: Thermal inspection.

**TOTAL: 45 HOURS**

#### **TEXT BOOK:**

1. Non-Destructive Testing by Warren J.Mcgomnagle, McGrawhill.
- 2.Non-DestructiveTestingbyBaldevRajet.al.,NarosaPublishingHouse.

**REFERENCES:**

1. Non-Destructive Testing by P.Halmshaw, 2<sup>nd</sup> Edition, 1991.
2. Metals Handbook, 8<sup>th</sup> Edition, Volume 11: Non-destructive Inspection and Quality Control, 1976.

|        |                                  |   |   |   |   |
|--------|----------------------------------|---|---|---|---|
| ME32A8 | MECHANICS OF COMPOSITE MATERIALS | L | T | P | C |
|        |                                  | 3 | 0 | 0 | 3 |

**AIM:**

To study the detail about the mechanics of composite materials.

**OBJECTIVE:**

- To acquire knowledge in composite material and its application.
- To acquire knowledge in fiber reinforced plastics, analysis micro mechanics of lamina, Metal Matrix Composites and Fabrication.

| Course Outcome - COs |                                                                                                                                                                       | Cognitive Skill |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Gain knowledge about composite material, types and characteristics and its application of various fields.                                                             | R,U,A           |
| CO-02                | The students will acquire knowledge in Various types of fiber-reinforced plastics processing techniques.                                                              | R,U,A           |
| CO-03                | Able to gain knowledge about the analysis of mechanics of lamina evaluation of elastic modeling. Two-dimensional relationship of compliance and its stiffness matrix. | R,U,A ,An       |
| CO-04                | Analyze The clear knowledge about the maximum mechanics of a lamina and its stress-strain relationship for a lamina with numerical problems.                          | R, An           |
| CO-05                | Student on completion of this course, the students can able to analyze the fiber reinforced Laminate for optimum design.                                              | R, An           |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

## Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-<br>A | PO-<br>B | PO-<br>C | PO-<br>D | PO-<br>E | PO-<br>F | PO-<br>G | PO-<br>H | PO-<br>I | PO-<br>J | PO-<br>k | PO-<br>L |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| CO-01    | S        | M        | M        | L        | N        | M        | L        | L        | M        | M        | M        | M        |
| CO-02    | S        | S        | M        | L        | N        | M        | L        | L        | M        | M        | M        | M        |
| CO-03    | S        | S        | M        | L        | N        | S        | L        | L        | M        | M        | L        | M        |
| CO-04    | S        | S        | M        | L        | N        | S        | L        | L        | M        | M        | L        | M        |
| CO-05    | S        | M        | M        | L        | N        | M        | L        | L        | M        | M        | M        | M        |

S- Strong, M- Medium, L-Low, N- Not Relevant

### UNIT-I: INTRODUCTION TO COMPOSITE MATERIALS APPLICATIONS

9

Introduction To Composite Materials: Definition, classification and characteristics of composite Materials fibrous composites, laminated composites, particulate composites. Applications: Automobile, Aircrafts. missiles. Space hardware, Electrical and electronics, Marine, recreational and sports equipment, future potential of composites.

### UNIT-II: FIBER REINFORCED PLASTIC PROCESSING

9

Layup and curing, fabricating process, open and closed mould process, hand layup techniques; structural laminate bag molding, production procedures for bag molding; filament winding, pultrusion, pulforming, thermo-forming, injection molding, blow molding.

### UNIT-III: MICRO MECHANICAL ANALYSIS OF A LAMINA MECHANICS OF ALAMINA

9

Micro Mechanical Analysis of a Lamina: Introduction, Evaluation of the four elastic moduli by Rule of mixture, Numerical problems. Macro Mechanics of a Lamina: Hooke's law for different types of materials, Number of elastic constants, Two-dimensional relationship of compliance and stiffness matrix.

### UNIT-IV : MACRO MECHANICS OF ALAMINA

9

Macro Mechanics of a Lamina Hooke's law for two-dimensional angle lamina, engineering constants - Numerical problems. Stress-Strain relations for lamina of arbitrary orientation, Numerical problems.

### UNIT-V : ANALYSIS OF LAMINATED FLAT PLATES

9

Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies

**TOTAL: 45 HOURS**

**TEXT BOOKS:**

1. Gibson, R.F., "Principles of Composite Material Mechanics", Second Edition, McGraw-Hill, CRC press in progress, 1994.
2. Hyer, M.W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw-Hill, 1998.

**REFERENCES:**

1. Issac M. Daniel and Ori Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition – 2007
2. Mallick, P.K., Fiber – Reinforced Composites: Materials, Manufacturing and Design", Manel Dekker Inc, 1993.
3. Halpin, J.C., "Primer on Composite Materials, Analysis", Techomic Publishing Co., 1984.

|               |                                |          |          |          |          |
|---------------|--------------------------------|----------|----------|----------|----------|
| <b>ME32A9</b> | <b>MACHINE TOOL TECHNOLOGY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**AIM:**

To study the principles of hydraulic transmission, erection, and testing of machine tools, and trends in the design of modern machine tools.

**OBJECTIVE:**

To gain fundamental knowledge in machine tools and their materials in the field of tools and their standard specifications

| Course Outcome - COs |                                                                                                                                                                                              | Cognitive Skill |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Students can be able to requirement regarding, quality economy, efficiency of machine tools and design aspects of electrical, mechanical, hydraulic and combination system.                  | R,U             |
| CO-02                | Gain knowledge about hydraulic transmissions, various elements and common hydraulic circuit for tool slide and work table.                                                                   | R,U             |
| CO-03                | Students can gain knowledge in vibration of machine tools.                                                                                                                                   | R,U,A           |
| CO-04                | To get an idea about the erection process, foundations' vibration and its isolation, maintenance of machine tools, and various test charts for different machines.                           | R,U             |
| CO-05                | Students are able to study the trends in the design of modern machine tools and the fundamental concepts of various controls, such as numerical, adaptive, and hydraulic, for machine tools. | R,U,A,          |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-02    | S    | S    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-03    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-04    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-05    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### UNIT I : 9 **PRINCIPAL REQUIREMENTS AND SPECIFICATIONS**

Requirements regarding quality of performance (Accuracy and surface finish) Productivity(Rate of motel renewal) Economy and efficiency of machine tools .Design aspects Kinematic principles in machine tools with respect to the basic elements and their design tool - column,frame,slides,guideways,shafts,spindles,bearings,clutches, Rigidity of machine tools structures, sources, effects, and elimination of vibration, machine tools drives and their kinematics (electrical, mechanical, hydraulic, and combination systems), and design of a stepped gearbox.

#### UNIT II: 9 **HYDRAULIC TRANSMISSION SYSTEM**

Hydraulic power transmission systems used in machine tools and their various elements. A few Common hydraulic circuits are used to control the movement of tool slides and worktables.

#### UNIT III: 9 **VIBRATION IN MACHINE TOOLS**

Forced Vibration, self-excited vibration, stick-slip vibration and its minimization, vibration isolation.

#### UNIT IV: 9 **ERECTION AND TESTING OF MACHINE TOOLS**

Location and layout, foundations, vibration isolation, erection process, principles of acceptance tests, measuring equipment and methods, direction of tolerances, maintenance of machine tools, test charts for different machines.

#### UNIT V: 9 **TRENDS IN THE DESIGN OF MODERN MACHINE TOOLS**

Aims and future development- Design for improved static and dynamic performance Fundamental aspects of numerical control, adaptive control, and hydraulic control of machines tools.

**. TOTAL: 45 HOURS**

#### **Text Books:**

1. Machine Tools Design, N. K. Meheta, TMH.
2. Design of Machine Tools, S. K. Basu, D. K. Pal, OIBH.
3. Principles of Machine Tools, G. C. Sen, Bhattacharya, New Central Book Agency.
4. Metal Cutting Theory and Practice, A. Bhattacharya, New Central Book Agency (P) Ltd.
5. Machining and Machine Tools, A. B. Chattopadhyay, Wiley-India Publication.

|        |                           |   |   |   |   |
|--------|---------------------------|---|---|---|---|
| ME32B1 | NUCLEAR POWER ENGINEERING | L | T | P | C |
|        |                           | 3 | 0 | 0 | 3 |

**AIM:**

To study the various means and process of nuclear power engineering,

**OBJECTIVE:**

To gain fundamental knowledge about nuclear physics, nuclear reactors, and nuclear fuels, reactors and safe disposal of nuclear wastes.

| Course Outcome - COs |                                                                                            | Cognitive Skill |
|----------------------|--------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Graduates shall display technical knowledge in the nuclear physics.                        | R,U,            |
| CO-02                | Gain knowledge In nuclear reactions and reaction materials.                                | R,U             |
| CO-03                | Evaluate the reprocessing of nuclear fuel, characteristic of fuels, extraction of solvent. | R,U,            |
| CO-04                | Gain knowledge about the various nuclear reactors.                                         | R,U,            |
| CO-05                | Capable of studying the separation of reactor products.                                    | R,U,            |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

**Mapping of Course Outcome with Programme Outcome**

| CO \ PO | PO               |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |                  |
|---------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
|         | P<br>O<br>-<br>A | P<br>O<br>-<br>B | P<br>O<br>-<br>C | P<br>O<br>-<br>D | P<br>O<br>-<br>E | P<br>O<br>-<br>F | P<br>O<br>-<br>G | P<br>O<br>-<br>H | P<br>O<br>-<br>I | P<br>O<br>-<br>J | P<br>O<br>-<br>k | P<br>O<br>-<br>L |
| CO-01   | S                | M                | M                | L                | N                | M                | L                | L                | M                | M                | M                | M                |
| CO-02   | S                | S                | M                | L                | N                | M                | L                | L                | M                | M                | M                | M                |
| CO-03   | S                | S                | M                | L                | N                | S                | L                | L                | M                | M                | L                | M                |
| CO-04   | S                | S                | M                | L                | N                | S                | L                | L                | M                | M                | L                | M                |
| CO-05   | S                | M                | M                | L                | N                | M                | L                | L                | M                | M                | M                | M                |

S- Strong, M- Medium, L-Low, N- Not Relevant

**UNIT-I**

**NUCLEAR PHYSICS**

**9**

Nuclear model of an atom-Equivalence of mass and energy-binding- radio activity-half life-neutron interactions-cross sections

**UNIT-II                      NUCLEAR REACTIONS AND REACTION MATERIALS                      9**

Mechanism of nuclear fission and fusion- radio activity- chain reactions-critical mass and composition-nuclear fuel cycles and its characteristics-uranium production and purification-Zirconium, thorium, beryllium.

**UNIT-III                                      REPROCESSING                                      9**

Reprocessing: nuclear fuel cycles-spent fuel characteristics-role of solvent extraction in reprocessing-solvent extraction equipment.

**UNIT-IV                                      NUCLEAR REACTOR                                      9**

Nuclear reactors: types of fast breeding reactors-design and construction of fast breeding reactors-heat transfer techniques in nuclear reactors- reactor shielding. Fusion reactors.

**UNIT-V                                      SEPARATION OF REACTOR PRODUCTS                                      9**

Processes to be considered - 'Fuel Element' dissolution - precipitation process – ion exchange - redox- purex - TTA - chelation -U235 - Hexone - TBP and thorax Processes - oxidative slaging and electro -refinng - Isotopes - principles of Isotope separation.

**TOTAL: 45 HOURS**

**REFERENCES:**

1. Glasstone, S. and Sesonske, A, Nuclear Reactor Engineering, 3<sup>rd</sup> Edition, Von Nostrand, 1984.
2. J. Kenneth Shultis, Richard E, Faw, Richard E. Faw, Fundamentals of Nuclear Science and Engineering, CRC Press, 2008.
3. Tatjana Tevremovic, Nuclear Principles in Engineering, Springer, 2008.
4. Kenneth D. Kok, Nuclear Engineering, CRC Press, 2009.
5. Cacuci, Dan Gabriel, Nuclear Engineering Fundamentals, Springer, 2010.
6. Lamarsh, J.R., Introduction to Nuclear Reactor Theory, Wesley, 1996.
7. Lalter, A.E. and Reynolds, A.B., Fast Breeder Reactor, Pergamon Press, 1981.
8. Winterton, R.H.S., Thermal Design of Nuclear Reactors, Pergamon Press, 1981.
9. Collier J.G., and G.F. Hewitt, " Introduction to Nuclear Power ", Hemisphere Publishing, 1987.

|               |                                          |          |          |          |          |
|---------------|------------------------------------------|----------|----------|----------|----------|
| <b>ME32B2</b> | <b>THEORY OF COMBUSTION AND EMISSION</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                          | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**AIM:**

Develop the students' knowledge in theory of combustion and emission

**OBJECTIVE:**

The students are able to analyze the combustion characteristics, combustion in various engines, and emissions.

| Course Outcome - COs |                                                                                      | Cognitive Skill |
|----------------------|--------------------------------------------------------------------------------------|-----------------|
| CO-01                | Able to analyze the combustion principles.                                           | R,U             |
| CO-02                | Capable of Analyzing the combustion in S.I.engines.                                  | R,U             |
| CO-03                | Students gain the knowledge about the combustion in S.I.engines.                     | R,U             |
| CO-04                | Analyze the combustion in gas turbines.                                              | R,U             |
| CO-05                | Gain Knowledge about combustion emission, control measures, and effects of emission. | R,U             |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-02    | S    | S    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-03    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-04    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-05    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

## UNIT-I COMBUSTION PRINCIPLES

9

Combustion Combustion equations, heat of combustion chemical equilibrium and Dissociation - Theories of combustion, flammability limits, reaction rates, laminar and turbulent flame propagation in engines. Introduction to spray formation and characterization.

## UNIT-II COMBUSTION IN S.I.ENGINES

9

SI Engine-introduction-carburetion- mixture requirements-Fuel supply - Ignition - Stages of combustion-Normal and abnormal combustion-factors affecting knock -Combustion chambers. CI engine- Injection systems-Mechanical and electronic-Combustion in CI engines-stages of combustion-Factors affecting combustion-Direct and indirect injection systems –Combustion chambers – Fuel spray behaviour – spray structure, spray penetration-and evaporation – air motion – Introduction to Turbo charging and supercharging. Basic concepts of engine simulation, governing equations, simulation of various engine processes for SI and CI Engines.

## UNIT-III COMBUSTION IN C.I.ENGINES

9

Stages of combustion, vaporization of fuel droplets and spray formation, air motion, swirl measurement, knock and engine variables, Features and design considerations of combustion chambers, delay period correlations, heat release correlations, Influence of the injection system on combustion, Direct and indirect injection systems.

**UNIT-IV** **COMBUSTION IN GAS TURBINES** **9**

Flame stability, Re-circulation zone and requirements-Combustion chamber configurations, Cooling, Materials.

**UNIT-V** **EMISSIONS** **9**

Main pollutants in engines, Kinetics of NO formation, NO<sub>x</sub> formation in SI and CI engines. Unburned-hydrocarbons, sources, formation in SI and CI engines, Soot formation and oxidation, Particulates in diesel engines, Emission control measures for SI and CI engines, Effect of emissions on Environment and human being.

**TOTAL: 45 HOURS**

**Text/Reference Books:**

1. V .Ganesan, Internal Combustion Engines, Tata McGraw Hill Book Co, 4<sup>th</sup> Edition, 2012.
2. John B. Heywood, Internal Combustion Engine Fundamentals, Tata Mc-Graw Hill, 2<sup>nd</sup> Edition, 2017.
3. Mathur, M. L, and Sharma. R. P., A Course in Internal Combustion Engines, Dhanpat Rai Publications, New Delhi.
4. Obert, E. F., Internal Combustion Engine and Air Pollution, International Text Book Publishers, 1973.
5. K.K. Ramalingam, Internal Combustion Engines, Scitech Publications (India) Pvt. Ltd, 2018

|               |                                 |          |          |          |          |
|---------------|---------------------------------|----------|----------|----------|----------|
| <b>ME32B3</b> | <b>ADVANCED FLUID MECHANICS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                 | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**AIM:**

The study of fluid dynamics is one of the fundamental disciplines in Mechanical Engineering. In the first part of the course, students will learn about boundary-layer theory, which is a key element of aerodynamic design. A guest lecture series on wind engineering will build on this knowledge to give students a perspective on one of the most important forms of renewable energy in our society today.

**OBJECTIVE:**

- This course is intended to consolidate your knowledge of fluid mechanics and to develop a critical and mature approach to the subject.
- It will supply the background preparation for more specialized courses on fluid mechanics.

| Course Outcome - COs |                                                                                                                                                                | Cognitive Skill |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Able to apply contemporary data analysis for experiments in the area of fluid mechanics, especially for experiments relating to boundary layers and turbulence | R,U,A           |
| CO-02                | Capable of applying the techniques of particle image velocimetry and hot-wire anemometry to investigate complex fluid flows.                                   | R,U,A           |
| CO-03                | Evaluate how the equations of fluid motion are applied to flows near walls.                                                                                    | R,U,A ,An       |
| CO-04                | Remember the importance of the boundary layer in engineering applications                                                                                      | R,U,A,An        |
| CO-05                | Gain knowledge about the inviscid irrotational flows.                                                                                                          | R,U,A,An        |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-02    | S    | S    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-03    | S    | :S   | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-04    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-05    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### UNIT-I: GOVERNING EQUATIONS & POTENTIAL FLOW 9

Review of kinematics of fluid motion - Method of describing fluid motion, translation, rate of deformation, the material derivatives, acceleration, vorticity in Cartesian and polar coordinates, Reynolds transport theorem, stress at a point, velocity profile, wall shear stress.

#### UNIT-II : A LAMINAR BOUNDARY LAYER 9

Boundary layer equations, Boundary layer thickness, Boundary layer on a flat plate, similarity solutions, Integral form of boundary layer equations, Approximate Methods, Flow separation, Entry flow into a duct.

#### UNIT-III : TURBULENT FLOW 9

Introduction, Fluctuations and time-averaging, General equations of turbulent flow, Turbulent boundary layer equation, Flat plate turbulent boundary layer, Turbulent pipe flow, Prandtl mixing hypothesis, Turbulence modeling, Free turbulent flows.

**UNIT-IV :****COMPRESSIBLE FLOWS****9**

Speed of sound and Mach number, Basic equations for one-dimensional flows, Isentropic relations, Normal-shock wave, Rankine-Hugoniot relations, Fanno and Rayleigh curve, Mach waves, Oblique shock wave, Prandtl-Meyer expansion waves, Quasi-one dimensional flows, Compressible viscous flows, Compressible boundary layers.

**UNIT-V :****INVISCID IRROTATIONAL FLOWS****9**

The Local Continuity Equation, Path Lines, Streamlines, and Stream Functions Newton's Momentum Equation, Equation for Newtonian fluid, Vorticity and Circulation, Non-Newtonian fluids, Moving coordinate systems Irrotational Flows and the Velocity Potential, Singularity Distribution Methods Forces Acting on a Translating Sphere, Added Mass and the Lagally Theorem

**TEXT BOOKS:**

1. Graebel. W.P, "Advanced Fluid Mechanics", 1<sup>st</sup> Edition, Academic Press, Elsevier Inc., 2007.
2. K. Muralidhar and G. Biswas, "Advanced Engineering Fluid Mechanics", 3<sup>rd</sup> Edition, Narosa Publishers, 2015.

**REFERENCE BOOKS:**

3. Stevan A Jones, "Advanced Methods for Practical Applications in Fluid Mechanics", InTech Publishers, 2012.
4. Hyoungh Woo Oh, "Advanced Fluid Mechanics", InTech Publishers, 2012
5. Roger Kinsky, "Fluid Mechanics Advanced Applications", McGraw-Hill Education Europe, 1997.

| ME32B4 | ADVANCED ENGINEERING THERMODYNAMICS | L | T | P | C |
|--------|-------------------------------------|---|---|---|---|
|        |                                     | 3 | 0 | 0 | 3 |

**AIM:**

The aim of thermodynamics is the study of the inter-conversion of heat, work, and other forms of energy.

**OBJECTIVE:**

- To analyze the equilibrium and kinetics of combustion of different fuels.
- To Apply the fundamental principles of thermodynamics to numerous engineering devices
- To use a systems approach to simplify a complex problem.

| Course Outcome - COs |                                                                                                           | Cognitive Skill |
|----------------------|-----------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Able to analyze energy and entropy from both a macroscopic and microscopic viewpoint.                     | R,U,A           |
| CO-02                | Capable of analyzing energy, availability, and irreversibility in closed and open thermodynamic systems   | R,U,A           |
| CO-03                | Apply mass, energy, entropy, and availability balance equations for closed and open thermodynamic systems | R,U,A,An        |
| CO-04                | Analyze maximum entropy and minimum energy principles                                                     | R,U,A,Ann       |
| CO-05                | Apply chemistry and physics of combustion                                                                 | R,U,A,Ann       |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-02    | S    | S    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-03    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-04    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-05    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### UNIT-I: ENTROPY CONSIDERATIONS

9

Review of laws of thermodynamics-Energy concepts for closed and open systems.. - Minimization of entropy generation principle and thermodynamic optimization.

#### UNIT-II: MULTI COMPONENT SYSTEMS

9

Different equations of state fugacity compressibility- principle of corresponding States- Use of generalized charts for enthalpy and entropy departure fugacity coefficient, Lee Kesler generalized three parameter tables. Fundamental property relations for systems of variable composition. Partial molar properties. Real gas mixtures-Ideal solution of real gases and liquid activity-equilibrium in multiphase systems-Gibbs phase rule for nonreactive components.

#### UNIT-III : CHEMICAL THERMODYNAMICS AND EQUILIBRIUM

9

Thermochemistry-First law analysis of reacting systems-Adiabatic flame temperature-entropy change of reacting systems - Second law analysis of reacting systems - Criterion for reaction equilibrium. Equilibrium constant for gaseous mixtures - evaluation of equilibrium composition.

**UNIT-IV : STATISTICAL THERMODYNAMICS 9**

Statistical thermodynamics- introduction, energy states and energy levels, macro and microscales, thermodynamic probability, Ideal Monatomic gas, Partition function, Calculation of The translational properties of an ideal monatomic gas, Sackur-Tetrode equation, and potential energy. function for a diatomic molecule, Rigid rotor harmonic oscillator approximation, Rotational and vibrational partition functions of ideal poly atomic gases.

**UNIT-V: CHEMISTRY ANDPHYSICS OF COMBUSTION 9**

Chemistry of Combustion: Basic Reaction Kinetics, Elementary reactions, Chain reactions, Multistep reactions, simplification of reaction mechanism, Global kinetics.  
Physics of Combustion: Fundamental laws of transport phenomena, Conservations Equations, Transport in Turbulent Flow.

**TOTAL: 45 HOURS**

**TEXT BOOKS:**

1. Moran, M. J., Shapiro, H. engineering thermo dynamics
2. Nag, P. K. (2013). Engineering thermodynamics.Tata McGraw-Hill Education.
3. Çengel, Y. A., & Boles, M. A, Thermodynamics: An Engineering Approach, McGraw-Hill,(2008).
4. Van Wylen, G. J., & Sonntag, R. E, Fundamentals of classical thermodynamics (No.536), 1985.
5. Hawkins, G. A, Engineering thermodynamics: an introductory textbook. John Wiley & Sons,1986.

**REFERENCES:**

1. D. D., & Bailey, M. B, Fundamentals of Wiley & Sons,2010.

|               |                                     |          |          |          |          |
|---------------|-------------------------------------|----------|----------|----------|----------|
| <b>AE32B5</b> | <b>COMPUTATIONAL FLUID DYNAMICS</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                     | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**AIM:**

The use of modern computational fluid dynamics (CFD) software in mechanical engineering involves building, solving, and visualizing fluid flow models to gain a deeper understanding of the principles of fluid mechanics.

**OBJECTIVE:**

To study the various discrimination methods and solving methodologies and to solve complex problems in the field of fluid dynamics.

| Course Outcome - COs |                                                                                                                                                                                                                                      | Cognitive Skill |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | The ability to provide a significant level of experience in the use of modern CFD software for the analysis of complex fluid-flow systems.                                                                                           | R,U,A           |
| CO-02                | Capable of improving the understanding of the basic principles of fluid mechanics.                                                                                                                                                   | R,U,A           |
| CO-03                | Enhance students' research and communication skills through self-directed, detailed study of a complex fluid-flow problem and the ability to communicate the results in written form.                                                | R,U,A,An        |
| CO-04                | Demonstrate the ability to use modern CFD software tools to build flow geometries, generate an adequate mesh for an accurate solution, select appropriate solvers to obtain a flow solution, and visualize the resulting flow field. | R,U,A,An        |
| CO-05                | Demonstrate an ability to recognize the type of fluid flow occurring in a particular physical system and to use the appropriate model equations to investigate the flow.                                                             | R,U,A,An        |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

#### Mapping of Course Outcome with Programme Outcome

| CO \ PO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|---------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01   | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-02   | S    | S    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-03   | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-04   | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-05   | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |

S- Strong, M- Medium, L-Low N- Not Relevant

#### UNIT-I :

#### FUNDAMENTAL CONCEPTS

9

Introduction - Basic Equations of Fluid Dynamics, Panel, methods - lifting flows over arbitrary bodies. Mathematical properties of Fluid Dynamics Equations - Elliptic, Parabolic and Hyperbolic equations, Discretization of Partial Differential Equations. Finite difference methods of subsonic, supersonic and viscous flows.

#### UNIT-II :

#### GRID GENERATION

9

Structured grids. Types and transformations. Generation of structured grids. Unstructured grids. Delaunay triangulation. Grid Independence study.

**UNIT-III : DISCRETIZATION 9**

Discretization of inviscid and viscous compressible flows, time-dependent methods. Concept of numerical dissipation Stability properties of explicit and implicit methods - Conservative upwind discretization for Hyperbolic systems, Up wind differencing.

**UNIT-IV: FINITE ELEMENT TECHNIQUES & FINITE DIFFERENCE METHODS 9**

Overview of Finite Element Techniques in Computational Fluid Dynamics. Finite difference methods Central, Upwind type discretization, Treatment of Derivatives.

**UNIT-V : FINITE VOLUME TECHNIQUES 9**

Finite Volume Techniques-Cell Centered Formulation-Lax-Wendroff Time Stepping-Runge-Kutta Time Stepping-Multi-stage Time Stepping-Accuracy-Cell Vertex Formulation-Multistage Time Stepping. Pressure correction solvers - SIMPLE, PISO. Implicit/semi-implicit schemes.

**TOTAL: 45 HOURS**

**TEXT BOOK:**

1.1.Fletcher,C.A.J.,ComputationalTechniquesforFluidDynamics,Vols.IandII,Springer- Verlag, Berlin, 1988.

**REFERENCES:**

- John F. Wendt (Editor), Computational Fluid Dynamics - An Introduction, Springer Verlag, Berlin,1992.
- Charles Hirsch, Numerical Computation of Internal and External Flows, Vols. I and II. John Wiley & Sons, New York,1988.
- Klaus A Hoffmann and Steve T. Chiang. Computational Fluid Dynamics or Engineers, Vols.I & II Engineering Education System, P.O.Box20078, W.Wichita, K.S.,67208 1078 USA, 1993.
- Anderson, Jr.D., Fundamentals of Aerodynamics, McGraw-Hill, 2000.

|               |                                      |          |          |          |          |
|---------------|--------------------------------------|----------|----------|----------|----------|
| <b>ME32B6</b> | <b>TECHNOLOGY OF SURFACE COATING</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                      | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**AIM:**

Graduates will gain and apply knowledge of the significance of surface engineered materials in modern engineering applications.

**OBJECTIVE:**

- To notify the learner about the various coatings on different areas.
- To know about nano structured coating techniques
- To haveknowledgeaboutthecoatingtechniquewithdifferenttypeofthesurfaces

| Course Outcome - COs |                                                                                                                      | Cognitive Skill |
|----------------------|----------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Able to explain the fundamentals of surface engineering.                                                             | R,U,A           |
| CO-02                | Illustrate the principles and evaluation of surface tribology, such as friction, wear, and corrosion.                | R,U,A           |
| CO-03                | Capable of selecting the suitable coating technique for surface treatment.                                           | R,U,A<br>,An    |
| CO-04                | Identify the surface modification of components using suitable characterization techniques.                          | R,U,A<br>,An    |
| CO-05                | Calculate the wear coefficient of given material and analyse the micro structure using scanning electron microscope. | R,U,A<br>,An    |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-02    | S    | S    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-03    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-04    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-05    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### UNIT I: INTRODUCTION 9

Introduction-Influence of different manufacturing processes on various surface and sub-surface properties; need of augmentation of surface properties; need from the view point of friction, wear, thermal barrier, erosion, corrosion etc.

#### UNIT II: TECHNIQUES OF DIFFERENT SURFACE ENGINEERING 9

Techniques of different surface engineering - Heat treatments, dip-coatings, galvanizing, painting, electrodepositions, physical vapour deposition processes, chemical vapour deposition processes, thick coating processes (like plasma spraying, high-velocity oxy-fuel spray, detonation gun spray, cold spray gun, etc.)

#### UNIT III: CORROSION 9

Definitions-explanation with suitable examples Factors affecting the choice of Engineering Material-Factors affecting Corrosion resistance-Dry Corrosion, Wet Corrosion, Fundamentals of corrosion, types of corrosions and electrochemical protection, protective coating, corrosion measurement

**UNIT IV: EXPERIMENTAL AND APPROACH 9**

Experimental and Approach - Evaluation of engineered properties control properties, response properties; surface geometry characterization techniques (conventional and recent trends); coating thickness measurements laboratory techniques and special techniques for accurate routine thickness measurements; adhesion measurement conventional methods and recent developments;

**UNIT V: TRIBOLOGY AND NANO TECHNOLOGY 9**

Tribology and Nanotechnology - Measurement of mechanical properties of engineered surfaces in nanoscale; Evaluation of tribological characteristics of engineered surfaces in macro, micro, and nanoscale; Simulation of actual application environment in tribometer.

**TOTAL: 45 HOURS**

**TEXT BOOK:**

1. SwarajPaul(Editor),SurfaceCoatings:ScienceandTechnology,2ndEditionISBN: 978-0-471-95818-5.
2. Fontana G., Corrosion Engineering, McGraw Hill,1985.

**REFERENCES:**

1. ChBudinski,K.G.,SurfaceEngineeringforWearResistance,PrenticeHall,1988.
2. Schweitzer, P.A., Fundamentals of corrosion, Mechanisms, causes and preventive methods, Taylor and Francis, Indian reprint, 2012.
3. ASM Metals Hand Book Volume 13 , Corrosion,1999
4. ASM Metals Hand book Volume 5, Surface Engineering, 1999.
5. Review,R.U.,Corrosion,HandBook2ndEdition,JohnWiley,2000.
6. Burakowski, T. and Wierzchon, T., Surface Engineering of Metals Principles, Equipment, Technologies,CRCpress, 1998.

|               |                                           |          |          |          |          |
|---------------|-------------------------------------------|----------|----------|----------|----------|
| <b>ME32B7</b> | <b>REFRIGERATION AND AIR-CONDITIONING</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                           | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**AIM:**

To enable the students to learn and develop the various concepts of refrigeration and air- conditioning.

**OBJECTIVE:**

The objectives of the course are to enable the student:

- To know the principles of refrigeration and air conditioning.
- To calculate the cooling load for different applications.
- To select the right equipment for a particular application.
- To design and implement refrigeration and air conditioning systems using standards.

| Course Outcome - COs |                                                                                    | Cognitive Skill |
|----------------------|------------------------------------------------------------------------------------|-----------------|
| CO-01                | Enable to impart knowledge on the principles of refrigeration and air-conditioning | R,U,A           |
| CO-02                | Capable of Studying the vapor compression refrigeration                            | R,U,A           |
| CO-03                | Able to impart knowledge on the other refrigeration systems                        | R,U,A<br>.An    |
| CO-04                | Impart knowledge on the air conditioning concepts and systems                      | R,U,A,An        |
| CO-05                | Gain knowledge on applications to refrigeration systems                            | R,U,A,An        |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-02    | S    | S    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-03    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-04    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-05    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### UNIT-I :

#### INTRODUCTION

9

Introduction- Necessity and applications; Air Refrigeration: Bell Coleman cycle and Brayton Cycle, Open and Dense air systems ; Refrigeration needs of Aircrafts. Refrigeration System Components-Compressors; Condensers, Evaporators, Expansion devices Principles. Refrigerants: Desirable properties ; classification refrigerants used ; Nomenclature; Ozone Depletion; Global Warming.

#### UNIT-II :

#### VAPOR COMPRESSION REFRIGERATION

9

Vapour Compression Refrigeration- Working principle and essential components of the system, effect of sub cooling and super heating; cycle analysis; Use of p- h charts; numerical Problems.

#### UNIT-III :

#### OTHER REFRIGERATION SYSTEMS

9

Vapor Absorption Refrigeration - Description and working of NH<sub>3</sub>-water system and LiBr-water (Two-shell & Four-shell) System. Principle of operation Three-Fluid absorption system, Steam Jet

Refrigeration System; Working Principle and Basic Components. Principle and operation of Thermoelectric refrigerator, Vortex tube or Hilsch tube.

**UNIT-IV : AIR CONDITIONING**

**9**

Introduction- Psychometric Properties & Processes; Characterization of Sensible and latent heat loads; Need for Ventilation, Consideration of Infiltration; Load concepts of RSHE, GSHE Problems, Concept of ESHE and ADP. Requirements of human comfort and concept of effective temperature; Comfort chart; Comfort Air conditioning; Requirements of Industrial air conditioning.

**UNIT-V : APPLICATIONS TO REFRIGERATION SYSTEM**

**9**

Applications to refrigeration systems – ice plant – food storage plants – milk –chilling plants – refrigerated cargo ships, central air conditioning systems – applications: car, train, industry, stores, and public buildings

**TEXT BOOKS:**

1. S.C.Arora, Domkundwar, Refrigeration and Air Conditioning, Dhanpat Rai and sons, 2009.
2. R.S. Khurmi and J.K Gupta, A Text book of Refrigeration and Air Conditioning, Eurasia publishing house private Ltd, 2015.

**REFERENCE BOOKS:**

1. Stoecker and Jones, Refrigeration and Air Conditioning, Tata McGraw Hill, New Delhi, 2003
2. Manohar Prasad, Refrigeration and Air Conditioning, Wiley Eastern Ltd, 2009.
3. Jordan and Prister, Refrigeration and Air Conditioning, Prentice Hall of India, New Delhi, 2011
3. J. Dossat, Principles of Refrigeration, Wiley Eastern Ltd, 2012.

**TOTAL: 45 HOURS**

|               |                           |          |          |          |          |
|---------------|---------------------------|----------|----------|----------|----------|
| <b>ME32B8</b> | <b>LEAN MANUFACTURING</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                           | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**AIM:**

Develop the students' knowledge in various design a globally competitive manufacturing and achieve continuous improvement of efficiency and productivity.

**OBJECTIVE:**

It is desired that at the end of the course, the student will be equipped with the basic knowledge of lean manufacturing, tools, techniques and implementation outcomes

| Course Outcome - COs |                                                                                | Cognitive Skill |
|----------------------|--------------------------------------------------------------------------------|-----------------|
| CO-01                | Able to endow the basic principles and applications of lean manufacturing      | R,U,A           |
| CO-02                | Enable to evaluate the primary and secondary tools of lean manufacturing.      | R,U,A           |
| CO-03                | Capable of analyzing the constructional and elements TQM tools and techniques. | R,U,A ,An       |
| CO-04                | Evaluate the basic principle and application of total productive maintenance   | R,U,A,An        |
| CO-05                | Remember the basic principle and application of six sigma                      | R,U,A,An        |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-02    | S    | S    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-03    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-04    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-05    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

### UNIT I: INTRODUCTION LEAN MANUFACTURING

9

Introduction, Definitions of Lean manufacturing, explaining basic concepts. Overview of historical development. Management theory.

### UNIT II: PRIMARY AND SECONDARY TOOLS OF LEAN MANUFACTURING 9

Primary Tools of Lean manufacturing: 5-S, Workplace organization, Total Productive Maintenance, Process mapping/ Value stream mapping, Work cell. Secondary Tools of Lean manufacturing: Objective and benefits of Secondary lean tool, Cause and Effect diagram, Pareto chart, Spider chart, Poka yoke, Kanban, Automation, Single minute exchange of die (SMED), Design for manufacturing and assembly, Just in time (JIT), Visual workplace, OEE.

### UNIT III: TQM TOOLS AND TECHNIQUES

9

The seven traditional tools of quality, New management tools, and Six sigma: Concepts, methodology, applications to manufacturing, service sector including IT, Bench marking, Reason to bench mark, Bench marking process, FMEA, Stages, and Types. Quality circles

,Quality Function Deployment (QFD), Taguchi quality loss function, TPM ,Concepts, improvement needs, Cost of Quality , Performance measures

#### **UNIT IV: TOTAL PRODUCTIVE MAINTENANCE**

**9**

Objectives and functions, Tero technology, Reliability Centered Maintenance (RCM), maintainability prediction, availability and system effectiveness, maintenance costs, maintenance organization. Minimal repair, maintenance types, balancing PM and breakdown maintenance, Primary and secondary tool for TPM, Case studies related to TPM.

#### **UNITV: SIX SIGMA**

**9**

Meaning of six sigma, Why six sigma, Six sigma improvement model, DMAIC and DMADV principle, building six sigma organization and culture, Six sigma application, case studies.

**TOTAL: 45 HOURS**

#### **TEXT BOOK:**

- 1.Mitra A., “Fundamentals of Quality Control and Improvement”, PHI, 2<sup>nd</sup> Ed., 1998.
2. J Evans and W Linsay, The Management and Control of Quality, 6<sup>th</sup> Edition, Thomson, 2005.
- 3.Besterfield, D H et al., “Total Quality Management”, 3<sup>rd</sup> Edition, Pearson Education, 2008.
4. D. C. Montgomery, Design and Analysis of Experiments, John Wiley & Sons, 6<sup>th</sup> Edition,2004.
5. Dale H.Besterfield, “Total Quality Management”, Pearson Education Asia.
- 6.Poornima Charantimath, “Total Quality Management”, Pearson Education in south Asia.
7. K C Jain and A K Chitale , “Quality Assurance and Total Quality Management (ISO-9000, QS-9000, ISO-14000) ”, Khanna Publishers,2003.
- 8.B. L. Hanson and P. M. Ghare, “Quality Control & Application”, Prentice Hall of. India, 2009.

| ME32B9 | DESIGN OF JIGS, FIXTURES AND PRESSTOOL | L | T | P | C |
|--------|----------------------------------------|---|---|---|---|
|        |                                        | 3 | 0 | 0 | 3 |

#### **AIM:**

Develop the student's knowledge in various types of jig, fixture, press working terminologies and elements of cutting dies.

#### **OBJECTIVE:**

- Explore the various locating and clamping methods.
- To analyze the functions and design principles of Jigs & Fixtures.
- To analyze the function and design principles of Press work and cutting die.

| Course Outcome - COs |                                                                                                   | Cognitive Skill |
|----------------------|---------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Able to apply the basic principle and function of jigs and fixtures.                              | R,U,            |
| CO-02                | Capable of analyzing the basic elements of jig systems.                                           | R,U,            |
| CO-03                | Study the general design principles of milling and boring systems.                                | R,U             |
| CO-04                | Able to illustrate The basic methods of press working terminologies and elements of cutting dies. | R,U,            |
| CO-05                | Remember and study the advanced press tools                                                       | R,U,            |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S- Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-02    | S    | S    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |
| CO-03    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-04    | S    | S    | M    | L    | N    | S    | L    | L    | M    | M    | L    | M    |
| CO-05    | S    | M    | M    | L    | N    | M    | L    | L    | M    | M    | M    | M    |

S- Strong, M- Medium, L-Low, N- Not Relevant

#### UNIT I: LOCATING AND CLAMPING PRINCIPLES 9

Objectives of tool design, function and advantages of jigs and fixtures, basic elements. Principles of location, locating methods and devices, rest pads and plates. Principles of clamping, types of clamps. Mechanical actuation, pneumatic and hydraulic actuation. Standard parts. Tolerances and materials used. Design of locator for given components. Design of clamp for given components.

#### UNIT II : DESIGN OF JIGS 9

Types of Jigs Post, Turn over, Channel, latch, box, pot, angular post jigs. Indexing jigs. Drill bushes and Jig buttons, method of construction. General considerations in the design of drill jigs - Design and development of jigs and for given component

#### UNIT III : DESIGN OF FIXTURES 9

General design principles of milling, lathe fixtures. General design principles of boring, broaching, and grinding fixtures. Assembly, inspection, and welding fixtures. Modular fixturing systems, quick-change fixtures. Design and development of fixtures for given components

**UNIT IV:****PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES 9**

Press Working Terminologies, operations, Types of presses, press accessories. Computation of press capacity, Strip layout, Material Utilization. Shearing action, Clearances, Press Work - Materials, Center of pressure, Design of various elements of dies. Die Block, Punch holder, Die set, guide plates, Stops, Strippers, Pilots, Selection of Standard parts. Design and preparation of four standard views of simple blanking, piercing, shaving, notching, compound and progressive dies.

**UNIT V : ADVANCED PRESS TOOLS 9**

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine blanking dies – recent trends in tool design – computer aided sheet metal forming. Tools for high velocity forming and pressure die casting.

**TOTAL: 45 HOURS**

**TEXT BOOKS:**

1. Joshi P.H. “ Jigs and Fixtures”, Tata McGraw Hill Publishing Co., Ltd., 2004.
2. Donaldson, Lecain and Goold, “Tool Design”, Tata McGraw Hill, 2012.

**REFERENCE BOOKS:**

1. K.Venkataraman, “ Design of Jigs and Fixtures & Press Tools”, Tata McGraw Hill, 2005.
2. Hoffman, “Jigs and Fixture Design”, Thomson Delmar Learning, Singapore, 2004.
3. Design Data Hand Book, PSG College of Technology, Coimbatore, 2012.
4. V.Balachandran, “Design of Jigs and Fixtures and Press tools”, Notion Press, 2015.

## OPEN ELECTIVES

| SL. NO. | COURSE CODE | COURSE TITLE                                  | L | T | P | C |
|---------|-------------|-----------------------------------------------|---|---|---|---|
| 1.      | ME32D1      | Supply Chain Management                       | 3 | 0 | 0 | 3 |
| 2.      | ME32D2      | Industrial Engineering and Psychology         | 3 | 0 | 0 | 3 |
| 3.      | ME32D3      | Mechanical Handling                           | 3 | 0 | 0 | 3 |
| 4.      | ME32D4      | Advanced Computer Graphics and Solid Modeling | 3 | 0 | 0 | 3 |
| 5.      | ME32D5      | Quality Assurance and Reliability             | 3 | 0 | 0 | 3 |

| ME32D1 | SUPPLY CHAIN MANAGEMENT | L | T | P | C |
|--------|-------------------------|---|---|---|---|
|        |                         | 3 | 0 | 0 | 3 |

### AIM:

This subject focuses on the management and improvement of supply chain processes. Students explore important supply chain metrics, primary trade-offs in making supply chain decisions, and basic tools for effective and efficient supply chain management. Topics include production planning and inventory control, order fulfillment, and supply chain coordination.

### OBJECTIVE:

- An understanding of the primary differences between logistics and supply chain management.
- An understanding of the individual processes of supply chain management and their interrelationships within individual companies and across the supply chain.
- An understanding of the management components of supply chain management.
- To learn the tools and techniques useful in implementing supply chain management.
- To understand the knowledge about the professional opportunities in supply chain management.

| Course Outcome – Cos |                                                                                                                                         | Cognitive Skill |
|----------------------|-----------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01                | Able to know basic terminology and supply chain operations in the context of today's business environment.                              | R,U,A           |
| CO-02                | Capable of studying effective inventory management policy, demand variability, forecasting, and lead time on inventory levels and cost. | R,U,A           |
| CO-03                | Illustrate the importance of strategic supply chain alliances and the impact of centralized versus decentralized networks.              | R,U,A           |
| CO-04                | Be able to recommend areas for improvement in logistics and supply chain operations.                                                    | R,U,A,An        |
| CO-05                | Gain knowledge about components of the logistics in the supply chain.                                                                   | R,U,A,An        |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

### Mapping of Course Outcome with Programme Outcome

| PO<br>CO     | PO-<br>A | PO-<br>B | PO-<br>C | PO-<br>D | PO-<br>E | PO-<br>F | PO-<br>G | PO-<br>H | PO-<br>I | PO-<br>J | PO-<br>k | PO-<br>L |
|--------------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| <b>CO-01</b> | S        | M        | M        | S        | M        | M        | M        | M        | M        | M        | L        | M        |
| <b>CO-02</b> | M        | S        | S        | S        | M        | M        | M        | M        | S        | M        | L        | S        |
| <b>CO-03</b> | S        | M        | M        | S        | M        | M        | M        | M        | L        | S        | M        | M        |
| <b>CO-04</b> | S        | S        | S        | S        | M        | M        | M        | M        | L        | M        | S        | M<br>S   |
| <b>CO-05</b> | S        | M        | M        | S        | N        | M        | M        | M        | L        | M        | M        | M        |

S-Strong, M-Medium, L-Low, N- Not Relevant

#### **UNIT I: INTRODUCTION & SUPPLY CHAIN NETWORK DESIGN 9**

**INTRODUCTION:** Definition, house of Supply Chain Customer Satisfaction, Integration, Coordination - Decision Phases in a Supply Chain, Objectives of SCM, Examples of Supply Chains, Supply Chain Drivers, Supply Chain Performance Measures:

**SUPPLY CHAIN NETWORK DESIGN:** Data collection data aggregation, transportation modes and rates, mileage estimation, warehouse costs, warehouse capacity, potential warehouse locations, service level requirements and future demand. Network design in the supply chain factors influencing the network design, framework for network design decisions, models for facility location and capacity allocation capacitated plant location model.

#### **UNIT II: INVENTORY MANAGEMENT 9**

Single warehouse inventory model- cycle inventory economies of scale to exploit fixed costs, quantity discounts, short term discounting, multi-echelon inventory, example problems. Managing uncertainty safety inventory in the supply chain safety level estimation, impact of supply uncertainty, impact of aggregation, impact of replenishment policies, managing safety inventory in multi echelon supply chain, managing safety inventory in practice product availability optimal level, affecting factors, supply chain contracts risk pooling examples. Value Information - Bullwhip Effect, Information, and Supply Chain Technology.

#### **UNIT III: DISTRIBUTION STRATEGIES, DISTRIBUTION NETWORK DESIGN AND STRATEGIES: 9**

Role of distribution in supply chain distribution network design factors influencing distribution network design .push strategy pull strategy Kanban replenishment systems, types, implementation, and push pull strategy demand driven strategy impact of internet on supply chain strategy. Distribution networks in practice direct shipment, cross docking, warehousing, transshipment.

#### **UNIT IV: STRATEGIC ALLIANCE, CUSTOMER VALUE AND GLOBAL SUPPLY CHAINS 9**

**STRATEGIC ALLIANCE:** Framework for Strategic Alliance - 3PL and 4PL, Retailer-Supplier Partnerships, Distribution Integration, Procurement and Outsourcing Benefits, Make/Buy Decisions, E-Procurement, Supplier Relationship Management, Supplier Scoring and Assessment, Supplier Selection and Contracts - E-Business and the Supply Chain, Design for Logistics, Supplier Integration into New Product Development, Mass Customization:

**CUSTOMER VALUE AND GLOBAL SUPPLY CHAINS:** Customer Value Dimensions, Strategic Pricing, Customer Value Measures, Information Technology, and Customer Value Customer Relationship Management

**UNIT V: LOGISTICS IN SUPPLY CHAIN****9**

Role of Transportation in Supply Chain – Factors Affecting Transportation Decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation

**TEXT BOOK:**

1. Sunil Chopra, Peter Meindland Kalra, "Supply Chain Management, Strategy, Planning, and Operation", Pearson Education, 2010.

**REFERENCES:**

1. Jeremy F. Shapiro, "Modeling the Supply Chain", South-Western Pub, 2<sup>nd</sup> Edition, 2006.
2. Srinivasan G.S, "Quantitative models in Operations and Supply Chain Management, PHI, 2010.

|               |                                              |          |          |          |          |
|---------------|----------------------------------------------|----------|----------|----------|----------|
| <b>ME32D2</b> | <b>INDUSTRIAL ENGINEERING AND PSYCHOLOGY</b> | <b>L</b> | <b>T</b> | <b>P</b> | <b>C</b> |
|               |                                              | <b>3</b> | <b>0</b> | <b>0</b> | <b>3</b> |

**AIM:**

- To Study Facility Planning, Production and Operation Management, Human Psychology, and Individual Workplaces:

**OBJECTIVE:**

- It Describes the Human Behaviour in a Given Situation or Condition
- To Understand Concepts of the Development, Improvement, Implementation, and Evaluation of Integrated Systems of People, Money, Knowledge, Information, Equipment, Energy, Material, and Process

| <b>Course Outcome - COs</b> |                                                                                                                                                             | <b>Cognitive Skill</b> |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| CO-01                       | Able to Learn Product Design, Lifecycle, Factors Affecting Plant Location, and Different Types of Layout.                                                   | R,U,A                  |
| CO-02                       | Gain Knowledge About the Various Techniques in Forecasting, Production Schedule and Control, and Computer Application in                                    | R,U,A                  |
| CO-03                       | Able to Study About Demand Forecasting and Cost Estimation.                                                                                                 | R,U,A,An               |
| CO-04                       | Gain Knowledge About the Work Psychology Basis on Job-Related Behavior and Psychology Test                                                                  | R,U,A,                 |
| CO-05                       | Capable of Knowing Time Study, Work Study, Organizational Culture, Leadership, Work Environment, Accident and Safety, Requirement, Training and Development | R,U,A,                 |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

**Mapping of Course Outcome with Programme Outcome**

| <b>PO<br/>CO</b> | <b>PO-A</b> | <b>PO-B</b> | <b>PO-C</b> | <b>PO-D</b> | <b>PO-E</b> | <b>PO-F</b> | <b>PO-G</b> | <b>PO-H</b> | <b>PO-I</b> | <b>PO-J</b> | <b>PO-k</b> | <b>PO-L</b> |
|------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| <b>CO-01</b>     | S           | M           | M           | M           | M           | M           | M           | M           | M           | M           | M           | M           |
| <b>CO-02</b>     | S           | S           | M           | M           | M           | M           | M           | M           | M           | M           | M           | M           |
| <b>CO-03</b>     | S           | S           | M           | M           | M           | S           | M           | M           | M           | M           | L           | M           |
| <b>CO-04</b>     | S           | S           | M           | M           | M           | S           | M           | M           | M           | M           | L           | M           |
| <b>CO-05</b>     | S           | M           | M           | M           | M           | M           | M           | M           | M           | M           | M           | M           |

S-Strong, M-Medium, L-Low, N- Not Relevant

**UNIT I: PRODUCT DESIGN & FACILITY PLANNING****9**

Principles of Good Product Design, Tolerance Design; Quality and Cost Considerations; Product Lifecycle; Standardization, Simplification, Diversification; Value Engineering and Analysis; Concurrent Engineering Facility Location Factors and Evaluation of Alternate Locations; Types of Plant Layout and Their Evaluation

**UNIT II: PRODUCTION MANAGEMENT****9**

Production Systems, Types, Demand Forecasting, Horizons, Techniques and Applications: Production Planning, Aggregate Planning, Master Production Scheduling, MPR, MRPII, Concept of ERP and Just in Time (JIT); Production Control, Modern Developments in Production and Operations Management, Computer Application in Production Management

**UNIT III: DEMAND FORECASTING AND COST****9**

Demand Forecasting and Cost Estimation: Characteristics of Forecasts, Forecasting Horizons, Steps to Forecasting, Forecasting Methods, Seasonal Adjustments, Forecasting Performance Measures, Cost Estimation, Elements of Cost, Computation of Material Variances, Break-Even Analysis.

**UNIT IV: PSYCHOLOGY****9**

Introduction: Definition, Nature, and Development of Work Psychology, Methods of Research, Basis of Job-Related Behavior - Individual and Situational Variables. Individual and Their Evaluation, Role of Heredity, Environment, Types of Individual. Psychological Tests in Industries, Their Utility, Reliability, and Validity. Counselling.

**UNIT V: INDIVIDUAL IN WORKPLACE****9**

Time Study, Work Study, Stress Management. Organizational Culture, Leadership & Group Dynamics. Work Environment & Engineering Psychology - Fatigue. Accidents and Safety. Job Analysis, Recruitment, and Selection. Reliability & Validity of Recruitment Tests. Performance Management: Training & Development

**TOTAL: 45 HOURS****TEXT BOOKS:**

1. O.P. Khanna, "Industrial Engineering and Management", Khanna Publishers.
2. T.R. Banga and S.C. Sarma, "Industrial Engineering and Management Science", Khanna Publishers, 1987.

**REFERENCE BOOKS:**

1. Ralph M Barnes, "Motion and Time Study", John Wiley & Sons Work Study, 2017.
2. Ernest J Mc Cormick, "Human factors in Engineering & Design", TMH. 150 | Page
3. Paneer Selvam, "Production & Operation Management", PHI.
4. NVS Raju, "Industrial Engineering and Management", Cengage Learning.

| ME32D3 | MECHANICAL HANDLING SYSTEMS | L | T | P | C |
|--------|-----------------------------|---|---|---|---|
|        |                             | 3 | 0 | 0 | 3 |

**AIM:**

To Study Elements, Selection, Design of Various Material Handling Equipment and Load-Lifting Attachment.

**OBJECTIVE:**

This Course is designed to understand the Basic Concepts of Materials Handling, Selection and Design of Materials Handling Systems, Cost Analysis for Design of Components of Materials Handling Systems, Objectives of Storage, Bulk Material Handling, Gravity Flow of Solid through Slides and Chutes, Storage and Warehouse Planning, and Computerized Warehouse Planning. At

the End of This Course, Students Will Be Able to Understand and Design the Various Material Handling Systems as per Requirements.

| Course Outcome -COs |                                                                                                                                                        | Cognitive Skill |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| CO-01               | Able to Know Objectives, Principles, and Benefits, Classification of Material Handling.                                                                | R,U,A           |
| CO-02               | Gain Knowledge About the Material Handling Equipment Analytical Techniques, Selection, Economical Analysis, and Parameters Affecting Material Handling | R,U,A.An        |
| CO-03               | Capable of Doing Design of Various Types of Hoists and Cranes for Industrial Applications                                                              | R,U,A           |
| CO-04               | Gain Knowledge to Design Various Lifting Attachments for Industrial Applications.                                                                      | R,U,            |
| CO-05               | Able to Study Automated Guided Vehicle System.                                                                                                         | R,U,            |

R- Remember, U-Understand, A-Apply, An-Analyze, E-Evaluate, S-Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | P<br>O<br>-<br>A | P<br>O<br>-<br>B | P<br>O-<br>C | P<br>O-<br>D | P<br>O-<br>E | P<br>O-<br>F | P<br>O<br>-<br>G | P<br>O-<br>H | P<br>O-<br>I | P<br>O-<br>J | P<br>O-<br>k | P<br>O-<br>L |
|----------|------------------|------------------|--------------|--------------|--------------|--------------|------------------|--------------|--------------|--------------|--------------|--------------|
| CO-01    | S                | M                | M            | M            | M            | M            | L                | M            | M            | M            | M            | M            |
| CO-02    | S                | S                | M            | M            | M            | M            | L                | M            | M            | M            | M            | M            |
| CO-03    | S                | S                | M            | M            | M            | S            | L                | M            | M            | M            | L            | M            |
| CO-04    | S                | S                | M            | M            | M            | S            | L                | M            | M            | M            | L            | M            |
| CO-05    | S                | M                | M            | M            | M            | M            | L                | M            | M            | M            | M            | M            |

S-Strong, M-Medium, L-Low, N- Not Relevant

**UNIT I: ELEMENTS OF MATERIAL HANDLING SYSTEM****9**

Importance, Terminology, Objectives, and Benefits of Better Material Handling; Principles and Features of Material Handling System; Interrelationships Between Material Handling and Plant Layout, Physical Facilities, and Other Organizational Functions; Classification of Material Handling Equipment.

**UNIT II: SELECTION OF MATERIAL HANDLING EQUIPMENT****9**

Factors Affecting for Selection; Material Handling Equation; Choices of Material Handling Equipment; General Analysis Procedures; Basic Analytical Techniques; The Unit Load Concept; Selection of Suitable Types of Systems for Applications; Activity Cost Data and Economic Analysis for Design of Components of Material Handling Systems; Functions and Parameters Affecting Service; Packing and Storage of Materials.

**UNIT III: DESIGN OF MECHANICAL HANDLING EQUIPMENT****9**

Design of Hoists, Drives for Hoisting, Components, and Hoisting Mechanisms; Rail Traveling Components and Mechanisms; Hoisting Gear Operation During Transient Motion; Selecting the Motor Rating and Determining Breaking Torque for Hoisting Mechanisms. Design of Cranes, Hand-Propelled and Electrically Driven E.O.T. Overhead Travelling Cranes; Traveling Mechanisms of Cantilever and Monorail Cranes; Design Considerations for Structures of Rotary Cranes with Fixed Radius; Fixed Post and Overhead Travelling Cranes; Stability of Stationary Rotary and Traveling Rotary Cranes.

**UNIT IV: DESIGN OF LOAD LIFTING ATTACHMENTS****9**

Load Chains and Types of Ropes Used in Material Handling System; Forged, Standard, and Ramshorn Hooks; Crane Grabs and Clamps; Grab Buckets; Electromagnet; Design Consideration for Conveyor Belts; Application of Attachments.

**UNIT V: AUTOMATED GUIDED VEHICLE SYSTEM****9**

Types of Vehicles and AGVs Applications – Vehicle Guidance Technology – Vehicle Management and Safety. Storage System Performance – Storage Location Strategies – Conventional Storage Methods and Equipments – Automated Storage/Retrieval System and Carousel Storage System. Deadlocks in Automated Manufacturing Systems - Petrinet Models – Applications in Deadlock Avoidance - Hurwicz Criterion - Expected Monetary Value Criterion - Expected Value of Perfect Information (E.V.P.I.)

**TOTAL:45HOURS****Text Book(s):**

1. Rudenko.N, “Materials handling equipment”, 2<sup>nd</sup> Edition, Central Books Ltd, 1970.
2. Spivakovsy. A.O and Dyachkov.V.K, “Conveying Machines”, 2<sup>nd</sup> Edition, MIR publishers, 1985.

**Reference(s):**

1. Günter Ullrich and Paul A. Kachur Automated Guided Vehicle Systems: A Primer with Practical Applications”, Edition:1, Springer, 2015.
2. Ronald G. Askin, Charles R. Standridge, “Modeling and Analysis of Manufacturing Systems”, Edition:1, John Wiley & Sons, 1993.
4. Alexandrov.M, “Materials Handling Equipments”, Edition:1, MIR Publishers, 1981.

|        |                                               |   |   |   |   |
|--------|-----------------------------------------------|---|---|---|---|
| ME32D4 | ADVANCED COMPUTER GRAPHICS AND SOLID MODELING | L | T | P | C |
|        |                                               | 3 | 0 | 0 | 3 |

### ADVANCED COMPUTER GRAPHICS AND SOLID MODELING 3 0 03

#### AIM:

The students can able to understand various Graphics Applications in real-world scenarios to solve engineering problems.

#### OBJECTIVE:

- To introduce various Graphics Applications in real-world scenarios.
- To be familiar with image fundamentals and animations.
- To learn more about 2D, 3D, and Curve applications.
- Applying efficient graphics techniques to solve engineering problems.

| Course Outcome -COs |                                                                                       | Cognitive Skill |
|---------------------|---------------------------------------------------------------------------------------|-----------------|
| CO-01               | Able to Compare various graphics algorithms used in 2D and 3D.                        | R,U,A           |
| CO-02               | Able to study fundamentals of graphics used in various real-life applications.        | R,U,A           |
| CO-03               | Capable of identifying the performance characteristics of graphics algorithms.        | R,U,            |
| CO-04               | Employ algorithm to model engineering problems, when appropriate.                     | R,U,            |
| CO-05               | Provide students with the understanding of computer-aided design of machine elements. | R,U,An          |

R- Remember, U-Understand, A-Apply, An-Analyze,E-Evaluate, S-Synthesis

#### Mapping of Course Outcome with Programme Outcome

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | M    | M    | L    | M    | M    | M    | M    | M    | M    | M    |
| CO-02    | S    | S    | M    | M    | L    | M    | M    | M    | M    | M    | M    | M    |
| CO-03    | S    | S    | M    | M    | L    | S    | M    | M    | M    | M    | L    | M    |
| CO-04    | S    | S    | M    | M    | L    | S    | M    | M    | M    | M    | L    | M    |
| CO-05    | S    | M    | M    | M    | L    | M    | M    | M    | M    | M    | M    | M    |

S-Strong, M-Medium, L-Low, N- Not Relevant

## **UNIT I : PRINCIPLES OF COMPUTER GRAPHICS**

**9**

Principles of computer graphics: Introduction, graphic primitives, point plotting, lines, Bradenham's circle algorithm, ellipse, transformation in graphics, coordinate systems, view port, 2D and 3D transformation, hidden surface removal, reflection, shading and generation of character.

## **UNIT II: GEOMETRIC MODELING**

**9**

Representation of curves includes Hermite curves, Bezier curves, B-spline curves, and rational curves. Techniques for surface modeling involve surface patching, including Coons and bicubic patches, as well as Bezier and B-spline surfaces. Solid modeling techniques encompass CSG (Constructive Solid Geometry) and B-Rep (Boundary Representation).

## **UNIT III: INTRODUCTION TO SOLID MODELING**

**9**

The Design process. Different types of design process. Role of CAD in Design- Types and applications of design models. Computer representation of drawings. Three-dimensional modeling schemes. Wireframe model - Surface representation model. Solid modeling.

## **UNIT IV : INTRODUCTION TO CAD SOFTWARE**

**9**

Introduction to C++. Writing interactive programs to solve design problems using C++. Design problems using C++. Design problems using C++. Design problems using C++. Features of various solid-modeling packages. Comparison of various solid-modeling packages. Solid-modeling packages demonstration. Solid-modeling packages demonstration..

## **UNIT V : COMPUTER AIDED DESIGN OF MACHINE ELEMENTS**

**9**

Introduction to Machine Drawing. Introduction to Machine Elements. Drawing & plotting of Machine Elements. Drawing & plotting of Machine Elements using solid modeling packages. Drawing & plotting of Shafts. Drawing & plotting of Gears. Drawing & plotting of Pulleys. Drawing & plotting of Flywheel. Drawing & plotting of Connecting rods.

**TOTAL:45HOURS**

### **TEXT BOOKS:**

1. Ibrahim Zeid, "Mastering CAD/CAM", Tata McGrawHill, 2<sup>nd</sup> Edition, 2013.
2. P. N. Rao, "CAD/CAM Principles and Applications", Tata McGraw Hill, 3<sup>rd</sup> Edition, 2010.
3. M. P. Groover, E. Zimmers, "CAD/CAM Computer- Aided Design and Manufacturing", Pearson, 1<sup>st</sup> Edition, 2003.
4. R. Alavala Chennakesava, "CAD/CAM Concepts and Applications", PHI, 1<sup>st</sup> Edition, 2013.

### **REFERENCE BOOKS:**

1. Farid Amirouche, "Principles of Computer-Aided Design and Manufacturing, Pearson, 2<sup>nd</sup>

Edition, 2004.

2. P. Radha Krishnan, “CAD/CAM/CIM”, New Age International, 4<sup>th</sup> Edition, 2016.

3. Warren. S. Seames, “Computer Numerical Control Concepts and Programming”, Delmar Cengage Learning, 4<sup>th</sup> Edition, 2013.

|        |                                   |   |   |   |   |
|--------|-----------------------------------|---|---|---|---|
| ME32D5 | QUALITY ASSURANCE AND RELIABILITY | L | T | P | C |
|        |                                   | 3 | 0 | 0 | 3 |

#### AIM:

Make the students aware various aspects of quality control and reliability

#### OBJECTIVE:

- To understand the basic needs of quality in product development.
- To understand the basics in Statistical Process Control.

| Course Outcome -COs |                                                                                  | Cognitive Skill |
|---------------------|----------------------------------------------------------------------------------|-----------------|
| CO-01               | Able to know the concepts of quality assurance and statistical process control.  | R,U,A           |
| CO-02               | Capable of studying about various control charts for variables and attributes.02 | R,U,A           |
| CO-03               | Learn the various methods for sampling inspection.                               | R,U,A,An        |
| CO-04               | Make the students know about various sampling inspection methods.                | R,U,A,An        |
| CO-05               | Gain the knowledge about complex systems and maintainability.                    | R,U,A,An        |

R- Remember, U-Understand, A-Apply, An- Analyze, E-Evaluate, S-Synthesis

| PO<br>CO | PO-A | PO-B | PO-C | PO-D | PO-E | PO-F | PO-G | PO-H | PO-I | PO-J | PO-k | PO-L |
|----------|------|------|------|------|------|------|------|------|------|------|------|------|
| CO-01    | S    | M    | M    | M    | M    | M    | L    | S    | M    | M    | M    | M    |
| CO-02    | S    | S    | M    | M    | S    | M    | L    | S    | M    | M    | M    | M    |
| CO-03    | S    | S    | M    | M    | M    | S    | L    | S    | M    | M    | L    | M    |
| CO-04    | S    | S    | M    | M    | S    | S    | L    | S    | M    | M    | L    | M    |
| CO-05    | S    | M    | M    | M    | S    | M    | L    | S    | M    | M    | M    | M    |

S- Strong, M-Medium, L-Low, N- Not Relevant

### UNIT-I: QUALITY ASSURANCE AND STATISTICAL PROCESS CONTROL 9

Introduction - Definition of Quality, Quality function, Dimensions of Quality, Statistical methods for quality improvement, Quality costs. Brief discussion on sporadic and chronic quality problems. Introduction to statistical process control, chance and assignable causes variation. Basic principles of control charts, choice of control limits, sample size and sampling

frequency, rational subgroups. Analysis of patterns of control charts. Case Studies on application of SPC. Process capability and analysis.

**UNIT-II: CONTROL CHARTS FOR VARIABLES AND ATTRIBUTES 9**

Introduction, Objectives, Control Chart Technique, Control Charts for Variables, Control Chart for Mean(X-Chart), Range Chart (R-Chart), Standard Deviation Chart (S-Chart), Process Capability Analysis

**UNIT-III : SAMPLING INSPECTION 9**

Concept of accepting sampling, economics of inspection, Acceptance plans single, double, and multiple sampling. Operating characteristic curves construction and use. Determinations of average outgoing quality, average outgoing quality level, average total inspection, producer risk, and consumer risk, published sampling plans. Application of statistical theory of tolerances to design of tolerances in random assemblies and application in other areas.

**UNIT-IV : RELIABILITY AND LIFE TESTING: 9**

Failure models of components, definition of reliability, MTBF, Failure rate, common failure rate curve, types of failure, reliability evaluation in simple cases of exponential failures in series, parallel, and series-parallel device configurations. Redundancy and improvement factors evaluations.

**UNIT-V: COMPLEX SYSTEM AND MAINTAINABILITY 9**

Complex system - Reliability, reliability of series, parallel, standby systems, reliability prediction and system effectiveness. - Availability, economics of reliability engineering, replacement of items, maintenance costing and budgeting, reliability testing.

**TEXTBOOK:**

- 1.Statistical Process Control, by Eugene Grant, Richard Leaven worth, McGraw Hill.
- 2.Quality Engineering in Production Systems, by G Taguchi, McGraw Hill, 1989.
- 3.Optimization &Variation Reduction in Quality, by W.A. Taylor, Tata McGrawHill,1991

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**REFERENCEBOOK:**

1. Juran Quality Planning and Analysis, by Frank. M.Gryna Jr. McGraw Hill.
- 2.Taguchi Techniques for Quality Engineering, by Philippos,2<sup>nd</sup> Edition,McGrawHill,1996.
- 3.Reliability Engineering, by LS Srinath, AffiliatedEastWestPvtLtd,3<sup>rd</sup>Edition,1991.
4. Reliability Engineering, by E.Bala Guruswamy, Tata Mc Graw Hill, 1994.