

# **MALNAD COLLEGE OF ENGINEERING, HASSAN**

**(An Autonomous Institution Affiliated to VTU, Belagavi)**



**Autonomous Programmes**

**BACHELOR of ENGINEERING**

**DEPARTMENT OF MECHANICAL ENGINEERING**

**SCHEME and SYLLABUS**

**(2024-25 Admitted Batch)**

**V AND VI SEMESTERS (THIRD YEAR)**

**Academic Year 2026-27**

## **Department of Mechanical Engineering**

### **Vision of the institute**

To be an institute of excellence in engineering education and research,  
Producing socially responsible professionals.

### **Mission of the institute**

1. Create conducive environment for learning and research
2. Establish industry and academia collaborations
3. Ensure professional and ethical values in all institutional endeavors

### **Vision of The Department:**

To emerge as department of high repute in Mechanical Engineering and allied fields through effective teaching, learning process and research activities, operating with a sense of professional and social responsibility.

### **Mission of The Department:**

1. Empower students to scale high in their professional career through upskilling.
2. Effective association with higher institutes of learning, industry and research laboratories with emphasis on multi-disciplinary approach.
3. Encourage students to participate in sustainable projects.
4. Inculcate professional and ethical norms in all activities.

**Program Educational Objectives:**

**PEO 1:** Graduates will be able to apply engineering principles to develop products, processes or knowledge to solve mechanical and associated engineering problems for successful careers in mechanical engineering/higher education/research.

**PEO 2:** Graduates will acquire leadership qualities with strong communication skills along with professional and ethical values.

**PEO 3:** Graduates will be able to become entrepreneur / innovators to design and develop manufacturing systems and services to address social, technical and business challenges.

## PROGRAM OUTCOMES (POs)

Mechanical Engineering students shall be able to,

- 1. Engineering knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
- 2. Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
- 3. Design/Development of solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
- 4. Conduct investigations of complex problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modeling, analysis & interpretation of data to provide valid conclusions. (WK8).
- 5. Engineering tool usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modeling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
- 6. The engineer and the world:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
- 7. Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
- 8. Individual and collaborative team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary settings.
- 9. Communication:** Communicate effectively and inclusively within the community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.
- 10. Project management and finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
- 11. Life-long learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

## PROGRAM SPECIFIC OUTCOMES [PSOs]

|              |                                                                                                       |
|--------------|-------------------------------------------------------------------------------------------------------|
| <b>PSO1:</b> | Apply the knowledge of design engineering skills to manufacture an engineering mechanical system.     |
| <b>PSO2:</b> | Model, simulate, analyze and optimize mechanical systems / processes through application of software. |

**Scheme of Evaluation (Theory Courses)**

|          | Portions for CIE                                                                          | Mode of Evaluation                                     | Weightage in Marks |
|----------|-------------------------------------------------------------------------------------------|--------------------------------------------------------|--------------------|
| CIE - 1  | Syllabus to be decided by the course coordinators such that all the COs shall be covered. | Descriptive Test                                       | <b>10</b>          |
| CIE - 2  |                                                                                           | Descriptive Test                                       | <b>10</b>          |
| CIE - 3  |                                                                                           | Descriptive Test                                       | <b>10</b>          |
| Activity | Minimum of two activities to be conducted                                                 | Assignment / Case study/Practical/ Working model /Quiz | <b>20</b>          |
|          |                                                                                           | <b>Total</b>                                           | <b>50</b>          |

| Examination |                 | Maximum marks | Minimum marks to be scored           | Minimum Average marks to qualify   |
|-------------|-----------------|---------------|--------------------------------------|------------------------------------|
| <b>CIE</b>  | <b>Tests</b>    | <b>30</b>     | <b>12 (<math>\geq 40\%</math>)</b>   | <b>40 (<math>\geq 40\%</math>)</b> |
|             | <b>Activity</b> | <b>20</b>     | <b>08 (<math>\geq 40\%</math>)</b>   |                                    |
| <b>SEE</b>  |                 | <b>50</b>     | <b>17.5 (<math>\geq 35\%</math>)</b> |                                    |

**Scheme of Evaluation (Laboratory Courses)**

| Evaluation Type                                                                     | Evaluation modules                    | Marks     |
|-------------------------------------------------------------------------------------|---------------------------------------|-----------|
| Continuous internal Evaluation (CIE) in every lab session by the Course coordinator | Conduction of experiments             | 10        |
|                                                                                     | Observation and tabulation of results | 10        |
|                                                                                     | Record writing                        | 20        |
|                                                                                     | Viva voce/Quiz                        | 10        |
| <b>CIE</b>                                                                          |                                       | <b>50</b> |
| <b>SEE</b>                                                                          |                                       | <b>50</b> |

**Note:** The marks distribution to be made based on the rubrics for a particular laboratory course.

**MALNAD COLLEGE OF ENGINEERING, HASSAN**  
**B.E. in Mechanical Engineering**  
**Scheme of Teaching and Examinations 2024**  
**Outcome Based Education (OBE) and Choice Based Credit System (CBCS)**  
**2024 admitted Batch**  
**(Effective from the academic year 2026-27)**  
**V Semester B.E. Mechanical Engineering**

| Sl<br>NO     | Course Category<br>Course Code |         | Course Title                             | Teaching Hours/Week |          |                       |           |                      |
|--------------|--------------------------------|---------|------------------------------------------|---------------------|----------|-----------------------|-----------|----------------------|
|              |                                |         |                                          | Theory<br>Lecture   | Tutorial | Practical<br>/Drawing | Credits   | Duration in<br>hours |
|              |                                |         |                                          | L                   | T        | P                     | C         |                      |
| 1            | HSMS                           | 24ME501 | Industrial Management & Entrepreneurship | 3                   | 0        | 0                     | 3         | 3                    |
| 2            | PCC                            | 24ME502 | Fluid Mechanics & Fluid Machines         | 3                   | 1        | 0                     | 4         | 5                    |
| 3            | PCC                            | 24ME503 | Machine Design                           | 3                   | 1        | 0                     | 4         | 5                    |
| 4            | PCCL                           | 24ME504 | Fluid Mechanics and Fluid Machines Lab   | 0                   | 0        | 2                     | 1         | 2                    |
| 5            | PCCL                           | 24ME505 | CNC Programming and 3-D Printing lab     | 0                   | 0        | 2                     | 1         | 2                    |
| 6            | PEC                            | 24ME55X | Professional Elective - I                | 3                   | 0        | 0                     | 3         | 3                    |
| 7            | PROJ                           | 24ME506 | Mini Project                             | 0                   | 0        | 4                     | 2         | 3                    |
| 8            | AEC                            | 24RIP   | Research Methodology and IPR             | 3                   | 0        | 0                     | 3         | 3                    |
| 9            | MC                             | 24EVS   | Environmental Studies                    | 0                   | 0        | 2                     | 1         | 2                    |
| <b>Total</b> |                                |         |                                          | <b>15</b>           | <b>2</b> | <b>10</b>             | <b>22</b> | <b>28</b>            |

| Professional Elective-I Course |         |                                |
|--------------------------------|---------|--------------------------------|
|                                | 24ME551 | Mechatronics                   |
|                                | 24ME552 | Project Management             |
|                                | 24ME553 | Quality Control and Management |
|                                | 24ME554 | Principles of CAD/CAM          |

|                     |                                                   |                     |                     |
|---------------------|---------------------------------------------------|---------------------|---------------------|
| <b>Course Title</b> | <b>INDUSTRIAL MANAGEMENT AND ENTREPRENEURSHIP</b> |                     |                     |
| <b>Course Code</b>  | <b>24ME501</b>                                    | <b>LTPC</b>         | <b>3-0-0-3</b>      |
| <b>Exam</b>         | <b>3 Hours</b>                                    | <b>Hours / Week</b> | <b>03 Hours</b>     |
| <b>SEE</b>          | <b>50Marks</b>                                    | <b>Total hours</b>  | <b>42L+48ABL=90</b> |

### Course objectives:

To develop proficiency for making rational decisions regarding problems likely to be encountered in professional practice, by applying management concepts and entrepreneurial skills.

Course Outcomes (COs) {with mapping shown against the Program Outcomes

(POs))Upon successful completion of this course, the student shall be able to

| # | Course Outcomes                                                                                                       | Mapping to POs | Mappin g to PSOs |
|---|-----------------------------------------------------------------------------------------------------------------------|----------------|------------------|
| 1 | Explain the basic concepts of management and entrepreneurship                                                         | 1, 8,9, 10, 11 | -                |
| 2 | Apply the conceptual knowledge of management and entrepreneurship to make rational decisions in professional practice | 1,8, 9,10,11   | -                |
| 3 | Utilize the initiatives by government and private institutions to boost entrepreneurial spirit                        | 1, 8,9, 10, 11 | -                |

### Course Contents:

| Module-I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 10Hrs. |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| <b>Management:</b> Introduction, Management functions, levels of management, Roles of a manager, Managerial skills,and Managerial effectiveness.<br><b>Planning:</b> Nature, importance and purpose of planning process, types of plans(meaning only), steps in planning & planning premises.                                                                                                                                                                                                                                                                                |        |
| Module-II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 11Hrs. |
| <b>Organizing:</b> Characteristics of an organization, types of organization, Process of organizing, Span of management, Departmentalization, Committees, Authority, Responsibility, Centralization and Decentralization. <b>Staffing:</b> Recruitment, Selection.<br><b>Directing:</b> Requirements of effective direction, Motivation: Maslow's need –hierarchy theory, Herzberg's Two-factor theory, Leadership styles. <b>Coordination:</b> meaning, importance and techniques. <b>Controlling:</b> Meaning, steps in controlling, essentials of a sound control system. |        |
| Module-III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 11Hrs  |
| <b>Entrepreneurship:</b> Introduction, steps in entrepreneurship, role of entrepreneurs in economic development, entrepreneurship in India, corporate entrepreneurship, entrepreneurial competencies, capacity building for entrepreneurs, myths about entrepreneurship, environmental factors affecting entrepreneurial growth, creating a favorable environment for entrepreneurship.                                                                                                                                                                                      |        |
| Module-IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 10Hrs. |
| <b>MSME:</b> Role and importance, concepts and definitions, government policy initiatives for MSME, schemes for MSME, role of clusters in promoting MSME, problems in MSME sector, impact of liberalization, privatization and globalization of MSME sector, effect of WTO/GATT. Institutions supporting business enterprises: Central, state level and other institutions.                                                                                                                                                                                                  |        |

**Self-Study Component:****Case Study: Study real companies (manufacturing or startup-based) and analyze:**

- Organizational structure
- Production/operations management
- Leadership style
- Financial and marketing strategies
- Entrepreneurial journey and challenges

**Mini Business Plan Development**

Create a startup idea and prepare:

- Problem statement
- Product/service idea
- Market analysis
- Cost estimation
- Revenue model
- SWOT analysis
- Risk assessment

**Industry Visit / Virtual Study**

Visit a local manufacturing unit or MSME and observe:

- Plant layout
- Inventory management
- Quality control
- HR practices
- Safety measures

**Entrepreneur Interview Project**

Interview a local entrepreneur or business owner and study:

- How they started
- Funding challenges
- Workforce management
- Growth strategy
- Failures and lessons learned

**Text Book:**

1. Principles of Management, P C Tripathi, P N Reddy & Ashish Bajpai, Tata McGraw Hill, Seventh Edition, 2021. ISBN:9789354600630
2. Entrepreneurship development and small business enterprises, Poornima M Charantimath, Pearson, Fourth Edition, 2025. ISBN: 978-9367138014

**Reference:**

<https://www.msme.gov.in/>

**Teaching -Learning– Evaluation Scheme:**

| Sl.No                                  | Teaching and Learning Method          | No. of Hours/ Week | No. of Weeks | Hours/ Semester |
|----------------------------------------|---------------------------------------|--------------------|--------------|-----------------|
| 1                                      | Class Room Teaching                   | 3                  | 14           | 42              |
| 2                                      | Integrated Lab Component              | -                  | -            | -               |
| 3                                      | Student Study Hours – Self Learning   | 1                  | 14           | 14              |
| 4                                      | Tutorial component                    | -                  | -            | -               |
| 5                                      | Activity Based Learning (ABL1 & ABL2) | -                  | -            | 26              |
| 6                                      | Evaluation of Learning Process        | -                  | -            | 08              |
| <b>Total Learning Hours / Semester</b> |                                       |                    |              | <b>90</b>       |



**Proposed Assessment Plan (for 50marks of CIE):**

| <b>Tool</b>      | <b>Remarks</b>                                                                                                                                                             | <b>Marks</b> |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| CIE              | Three CIEs conducted for 20 marks each and reduced to 10 marks                                                                                                             | 30           |
| Activity Details | Students can choose any two activities listed in the self-study component, and then prepare and present a report on the chosen activities. Each activity carries 10 marks. | 20           |
| <b>Total</b>     |                                                                                                                                                                            | <b>50</b>    |

**Activities Mapped to Modules:**

| <b>Module</b> | <b>Activity Description</b>                                                   | <b>Hours</b> |
|---------------|-------------------------------------------------------------------------------|--------------|
| 1 & 2         | Case Study: Study real companies (manufacturing or startup-based) and analyze | 10           |
| 3 & 4         | Mini Business Plan Development                                                | 10           |
| 1 & 2         | Industry Visit / Virtual Study                                                | 10           |
| 3 & 4         | Entrepreneur Interview Project                                                | 10           |
| <b>Total</b>  |                                                                               | <b>40</b>    |

**Evaluation of Learning Process (08 Hours)**

| <b>Type of Evaluation</b>        | <b>Hours</b> |
|----------------------------------|--------------|
| Test (1, 2 and 3)                | 03           |
| Presentation & Report Evaluation | 02           |
| Semester End Exam                | 03           |
| <b>Total</b>                     | <b>08</b>    |

**Course Articulation Matrix**

| <b>Course Outcomes</b> | <b>Program Outcomes [POs]</b> |            |            |            |            |            |            |            |            |             |             | <b>PSO's</b> |             |
|------------------------|-------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|--------------|-------------|
| <b>COs</b>             | <b>PO1</b>                    | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> | <b>PO6</b> | <b>PO7</b> | <b>PO8</b> | <b>PO9</b> | <b>PO10</b> | <b>PO11</b> | <b>PSO1</b>  | <b>PSO2</b> |
| <b>1</b>               | 2                             |            |            |            |            |            |            | 2          | 3          | 3           | 2           |              |             |
| <b>2</b>               | 2                             |            |            |            |            |            |            | 2          | 3          | 3           | 2           |              |             |
| <b>3</b>               | 2                             |            |            |            |            |            |            |            | 3          | 3           | 2           |              |             |

|                     |                                           |                     |                          |
|---------------------|-------------------------------------------|---------------------|--------------------------|
| <b>Course Title</b> | <b>FLUID MECHANICS AND FLUID MACHINES</b> |                     |                          |
| <b>Course Code</b>  | <b>24ME502</b>                            | <b>LTPC</b>         | <b>3-1-0-4</b>           |
| <b>Exam</b>         | <b>03 Hours</b>                           | <b>Hours / Week</b> | <b>05</b>                |
| <b>SEE</b>          | <b>50 Marks</b>                           | <b>Total hours</b>  | <b>52L+14T+54ABL=120</b> |

**Course Objective:** To impart the students with fundamental knowledge of fluid properties, concept of fluid flow & basics principles of energy conversion in turbomachines

**Course Outcomes (COs)** {with mapping shown against the **Program Outcomes (POs)**}

Upon completion of the course, students shall be able to:

| <b>COs</b> | <b>Statement</b>                                                                                                        | <b>POs</b> | <b>PSOs</b> |
|------------|-------------------------------------------------------------------------------------------------------------------------|------------|-------------|
| 1          | Apply the fundamental laws of fluid statics and kinematics to various hydraulic systems                                 | 1,2, 3,8,9 | -           |
| 2          | Apply fluid flow governing equations to design free surface & pipe flows.                                               | 1,2, 3,8,9 | -           |
| 3          | Analyze energy transfer, stage parameters and performance characteristics of various turbo machines.                    | 1,2, 3,8,9 | -           |
| 4          | Analyze energy transfer and perform the preliminary design of steam turbines, hydraulic turbines and centrifugal pumps. | 1,2, 3,8,9 | -           |

### **COURSE CONTENTS:**

| <b>Module –I</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>13 Hrs.</b> |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <p><b>Fluid statics:</b> Definition of fluid, Fluid properties (No derivation &amp; numerical problems), Classification of fluids, Pascal's Law and Hydrostatic Law, Pressure and its variation in a static Fluid, Measurement of static fluid pressure: Hydrostatic forces on Plane –Inclined and Curved surfaces, Buoyancy, Condition of Equilibrium for Submerged and Floating Bodies, Centre of Buoyancy, Metacenter–Determination of Metacentric Height (Analytical method)-Numerical Problems.</p> <p><b>Fluid kinematics:</b> Description of fluid motion – Lagrangian and Eulerian approach, Types of flows, Continuity equation, Continuity equation in three Dimension, velocity and acceleration, Streamlines, path lines and streak lines, Stream function and velocity potential function -Numerical Problems</p> |                |
| <b>Module –II</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>13 Hrs.</b> |
| <p><b>Fluid dynamics:</b> Euler and Bernoulli's equations, Practical application of Bernoulli's Equation– orifice meter, Venturi meter, Navier–Stokes Equations (No derivation) -Numerical Problems.</p> <p><b>Flow through pipes:</b> Measurement in pipe flow- Major loss, Darcy–Weisbach equation, Minor losses (Numerical problem), Hagen Poiseuille equation-laminar flow through circular pipe and flow between two parallel stationary plates- (No Numerical Problems).</p>                                                                                                                                                                                                                                                                                                                                             |                |
| <b>Module –III</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>12 Hrs.</b> |
| <p><b>Basics of Turbomachines:</b> Definition of turbo machine, parts of turbo machines, Comparison with positive displacement machines, Classification, Dimensionless parameters and their significance (No numerical questions on dimensional analysis), Unit and specific quantities, Euler's turbine equation, Alternate form of Euler's turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction, utilization factor, Relation between degree of reaction and Utilization factor, Numerical problems.</p> <p><b>Steam Turbine:</b> Classification, Single stage impulse turbine, Condition for maximum blade efficiency, Stage efficiency, Nozzle efficiency, Need and methods of compounding, Numerical problems.</p>                          |                |

| Module –IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                          | 12 Hrs. |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|---------|
| <p><b>Centrifugal pump:</b> Centrifugal pumps, Work done, Head developed, Pump output and Efficiencies, Priming, Minimum starting speed, Performance of multistage pumps, Cavitation, Methods of prevention, Pump characteristics, Numerical Problems.</p> <p><b>Hydraulic turbines:</b> Classification of hydraulic turbines, Pelton wheel - Francis turbine - Kaplan and Propeller turbines, Velocity triangles, Specific speed, Theory of draft tube, Performance characteristics, Selection of turbines, (Numerical Problems only on Pelton wheel.)</p>                                                                                          |                                          |         |
| <p><b>Self -Study Component:</b> Manometers, Pressure at a point, Relation between pressures, Reynolds transport theorem, Introduction to flow through pipes and channels, Types of flows, Reynolds experiment, Derived quantities, Introduction, Unit quantities</p>                                                                                                                                                                                                                                                                                                                                                                                |                                          |         |
| <b>Tutorials:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                          |         |
| 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Numerical problems on Fluid statics      |         |
| 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Numerical problems on Fluid statics      |         |
| 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Numerical problems on Fluid Kinematics   |         |
| 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Numerical problems on Fluid Dynamics     |         |
| 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Numerical problems on Flow through pipes |         |
| 6.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Numerical problems on Flow through pipes |         |
| 7.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Numerical problems on Turbo machine      |         |
| 8.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Numerical problems on Turbo machine      |         |
| 9.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Numerical problems on Steam turbine      |         |
| 10.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Numerical problems on Steam turbine      |         |
| 11.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Numerical problems on Centrifugal pump   |         |
| 12.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Numerical problems on Centrifugal pump   |         |
| 13.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Numerical problems on Hydraulic turbines |         |
| 14.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Numerical problems on Hydraulic turbines |         |
| <b>TEXTBOOKS:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                          |         |
| <ol style="list-style-type: none"> <li>Streeter V.L., Benjamin Wylie, —Fluid Mechanics, McGraw Hill Book Co., New Delhi, 1999, ISBN: 0070622426 9780070622425.</li> <li>An Introduction to Energy Conversion, Volume III, Turbo machinery, V. Kadambi and Manohar Prasad, New Age International Publishers, reprint 2008, ISBN 10: 8122431895 / ISBN 13: 9788122431896</li> </ol>                                                                                                                                                                                                                                                                    |                                          |         |
| <b>REFERENCE BOOKS:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                          |         |
| <ol style="list-style-type: none"> <li>Robert W. Fox, Alan T. McDonald, Philip J. Pirtchard John W. Mitchell, Introduction to Fluid Mechanics, 9th Edition, Wiley Publications, 2015.</li> <li>Dr. R. K. Bansal, A Textbook of Fluid Mechanics and Hydraulic Machines, 5th Edition, Laxmi Publication, 2012, New Delhi, ISBN-10: 8131808157; ISBN-13: 978-8131808153.</li> <li>Principals of Turbo machines, D. G. Shepherd, The Macmillan Company (1964), ISBN 10: 0024096601 / ISBN 13: 9780024096609.</li> <li>Fluid Mechanics &amp; Thermodynamics of Turbo machines, S. L. Dixon, Elsevier (2005), ISBN 9781856177931, 9780080962597</li> </ol> |                                          |         |

| Sl.No                         | Teaching and Learning Method          | No. of Hours/ Week | No. of Weeks | Hours/ Semester |
|-------------------------------|---------------------------------------|--------------------|--------------|-----------------|
| 1                             | Class Room Teaching & Learning        | 3                  | 14           | 42              |
| 2                             | Integrated Lab Component              | -                  | -            | -               |
| 3                             | Student Study Hours – Self Learning   | 1                  | 14           | 14              |
| 4                             | Tutorial Component                    | 1                  | 14           | 14              |
| 5                             | Activity Based Learning (ABL1 & ABL2) | -                  | -            | 44              |
| 6                             | Evaluation of Learning Process        | -                  | -            | 06              |
| Total Learning Hours/Semester |                                       |                    |              | 120             |

Assessment Plan (for 50 marks of CIE):

| Tool             | Remarks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Marks     |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| CIE              | Three CIEs conducted for 20marks each and reduced to 10 marks                                                                                                                                                                                                                                                                                                                                                                                                                                       | 30        |
| Activity Details | Details of activities to be conducted<br>1) Details of activity1-Students are advised to visit nearby Hydraulic power plant /Thermal power plant to study various fluid machinery concepts and to prepare a report on Industrial visit & present the same -10Marks<br><br>2) Details of activity2 –To Prepare simple working model (prototype) To demonstrate Basic concepts of Fluid Mechanics and prepare the report &present the same OR Energy Audit on Hydraulic /Thermal power plant -10Marks | 20        |
| <b>Total</b>     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>50</b> |

| Module       | Activity Description                                                                                                                                                           | Hours        |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 1            | Demonstrate the understanding of Fluid Mechanics, Properties of fluids, Hydrostatic forces, Measurement of pressure, Fluid statics - Buoyancy                                  | 6            |
| 2            | To apply the Bernoulli's energy equations (Venturimeter, Orificemeter, pitot tube etc.) to estimate rate of flow.                                                              | 6            |
| 3            | Develop visual, physical, and mathematical models in support of Fluid Mechanics and Machines problem design and analysis                                                       | 6            |
| 4            | FLUID-LABVIR: A Virtual Laboratory to Enhance Learning in Fluid Mechanics and Fluid Machines                                                                                   | 6            |
| 5            | Case studies: Municipal supply of water, Hydraulic power plant, Steam power plant, draining fluid from a tank, vertical rise of a weather balloon, wind drag forces on people, | 6            |
| <b>Total</b> |                                                                                                                                                                                | <b>30hrs</b> |

### Course Articulation Matrix

| Course Out comes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      |      |      |
|------------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| COs              | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1              | 3                      | 3   | 1   | -   | -   | -   | -   | 2   | 2   | -    | -    | -    | -    |
| CO2              | 3                      | 3   | 1   | -   | -   | -   | -   | 2   | 2   | -    | -    | -    | -    |
| CO3              | 2                      | 3   | 3   | -   | -   | -   | -   | 2   | 2   | -    | -    | -    | -    |
| CO4              | 2                      | 3   | 3   | -   | -   | -   | -   | 2   | 2   | -    | -    | -    | -    |

|                     |                       |                     |                          |
|---------------------|-----------------------|---------------------|--------------------------|
| <b>Course Title</b> | <b>MACHINE DESIGN</b> |                     |                          |
| <b>Course Code</b>  | <b>24ME503</b>        | <b>LTPC</b>         | <b>3-1-0-4</b>           |
| <b>Exam</b>         | <b>03 Hours</b>       | <b>Hours / Week</b> | <b>04</b>                |
| <b>SEE</b>          | <b>50 Marks</b>       | <b>Total hours</b>  | <b>52L+14T+54ABL=120</b> |

### Course objectives:

To design simple machine elements subjected to static and dynamic loads using the concepts of stress analysis and theories of failure.

**Upon completion of the course, students shall be able to:**

| COs | Statement                                                                                                                | POs       | PSOs |
|-----|--------------------------------------------------------------------------------------------------------------------------|-----------|------|
| 1.  | apply basic stress-strain analysis and failure theories to design machine elements subjected to static and dynamic loads | 1,2,3     | 1    |
| 2.  | design of mechanical elements such as curved beams and fasteners                                                         | 2,3,5,8,9 | 2    |
| 3.  | design of different types of gear drives for dynamic and wear considerations using standard practices                    | 2,3,5,8,9 | 2    |

### COURSE CONTENTS:

| <b>Module – 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <p><b>Introduction:</b> Mechanical engineering design, phases of design process, design considerations, engineering materials and their mechanical properties, review of definitions - normal, shear, biaxial and triaxial stresses, principal stresses. Design for static strength: theories of failure – maximum normal stress theory, maximum shear stress theory, distortion energy theory; brittle and ductile failure. Stress concentration, determination of stress concentration factor.</p> <p><b>Design for dynamic loads:</b> Impact strength: introduction, impact stress due to axial, bending and torsional loads, impact factor.</p> | <b>13 Hrs.</b> |
| <b>Module -2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                |
| <p><b>Fatigue loads:</b> Introduction, fatigue failure, definition of low cycle fatigue and high cycle fatigue, s-n diagram, endurance limit, correction factors for load, size and surface finish, fatigue stress concentration factor, notch sensitivity, factors affecting fatigue; goodman and soder-berg relationships. Problems on members subjected to fatigue due to axial, bending, torsion, and combined loads. <b>Curved Beams:</b> Winkler - Bach equation, Stresses in curved beams of standard cross sections used in crane hook, punching presses and clamps.</p>                                                                    | <b>13 Hrs.</b> |
| <b>Module – 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                |
| <p>Threaded Fasteners: Stresses in threaded fasteners. Effect of initial tension, design of threaded fasteners under static, dynamic and impact loads. Eccentrically loaded bolted joints, Riveted Joints: Failures of riveted joints, design of boiler joints as per IBR, eccentrically loaded riveted joints, Welded Joints – Types, strength of butt and fillet welds, eccentrically loaded welded joints.</p>                                                                                                                                                                                                                                   | <b>13 Hrs.</b> |
| <b>Module – 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                |
| <p><b>Design of Gears-</b> Spur and Helical Gears: Definitions, stresses in gear tooth, Lewis's equation and form factor, design for strength, dynamic and wear loads. Bevel Gear: Definitions, formative number of teeth, stresses in gear tooth, design for strength, dynamic and wear loads.</p>                                                                                                                                                                                                                                                                                                                                                 | <b>13 Hrs.</b> |

**Tutorials:**

1. Numerical on members subjected to static load
2. Numerical with respect to biaxial stresses acting on an object
3. Numerical on Theories of failure
4. Numerical on member subjected to axial impact load
5. Numerical on member subjected to bending impact load
6. Numerical on member subjected to repeated fatigue load
7. Numerical on member subjected to completely reversible fatigue load
8. Numerical on spur gears
9. Numerical on helical gears
10. Numerical on bevel gears
11. Numerical on worm gears
12. Numerical with respect to design of threaded fasteners
13. Numerical with respect to design of rivets
14. Numerical with respect to design of welded joints

**TEXTBOOK:**

1. Maleev&Hartman's, *Machine Design in SI units*, 6<sup>th</sup> Edition, C B S Publications, Delhi, 2015. ISBN:9788123926322

**REFERENCE BOOKS:**

1. M.F. Spotts, T.E. Shoup, L.E. Hornberger, S.R.Jayaram&C.V.Venkatesh, *Design of Machine Elements*, Pearson Education, 8<sup>th</sup> Edition, 2006. ISBN 9788177584219
2. Joseph Edward Shigley, *Mechanical Engineering Design*, Mc. Graw Hill, 8<sup>th</sup> Edition, 2008. ISBN:9780073529288.
3. V. B. Bhandari, *Design of Machine Elements*, TMH, 3<sup>rd</sup> Edition, 2007. ISBN:9780070681748

**DESIGN DATA HANDBOOKS:**

1. K. Mahadevan and Balaveera Reddy, *Design Data Handbook*, C B S Publications, Delhi. 4<sup>th</sup> edition, 2013. ISBN: 9788123923154.

**Teaching -Learning– Evaluation Scheme:**

| -                                    | Teaching and Learning Method            | No. of Hours/ Week | No. of Weeks | Hours/ Semester |
|--------------------------------------|-----------------------------------------|--------------------|--------------|-----------------|
| 1                                    | Class room teaching                     | 3                  | 14           | 42              |
| 2                                    | Integrated lab component                | -                  | -            | -               |
| 3                                    | Student study hours/self-learning       | -                  | -            | -               |
| 4                                    | Tutorials                               | 1                  | 14           | 14              |
| 5                                    | Activity based learning (ABL1 and ABL2) | -                  | -            | 58              |
| 6                                    | Evaluation of learning process          | -                  | -            | 06              |
| <b>Total Learning Hours/Semester</b> |                                         |                    |              | <b>120</b>      |

**Proposed Assessment Plan (for 50marks of CIE):**

| Tool                | Remarks                                                                                                                                                                            | Marks     |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| CIE                 | Three CIEs conducted for 20marks each and reduced to 10 Marks                                                                                                                      | 30        |
| Details of Activity | Details of activities to be conducted<br>Details of activity1- Case study on application of machine components - 10Marks<br>Details of activity2 – Preparing working model-10Marks | 20        |
| <b>Total</b>        |                                                                                                                                                                                    | <b>50</b> |

**Activities Mapped to Modules:**

| Module       | Activity Description                            | Hours     |
|--------------|-------------------------------------------------|-----------|
| 1,2,3,4      | Case study on application of machine components | 20        |
| 3            | Design and modelling of fasteners               | 20        |
| 4            | Design and modelling of gears                   | 18        |
| <b>Total</b> |                                                 | <b>58</b> |

**COURSE ARTICULATION MATRIX**

| Course Out comes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      |      |      |      |
|------------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| COs              | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1              | 3                      | 2   | 1   | -   | -   | -   | -   | -   | -   | -    | -    | -    | 1    | -    |
| CO2              | -                      | 3   | 2   | -   | 1   | -   | -   | 1   | 1   | -    | -    | -    | -    | 1    |
| CO3              | -                      | 3   | 2   | -   | 1   | -   | -   | 1   | 1   | -    | -    | -    | -    | 1    |

**Evaluation of Learning Process**

| Type of Evaluation  | Hours    |
|---------------------|----------|
| Test (1, 2 and 3) 3 | 3        |
| Semester End Exam 3 | 3        |
| <b>Total</b>        | <b>6</b> |

|                     |                                                      |                     |                     |
|---------------------|------------------------------------------------------|---------------------|---------------------|
| <b>Course Title</b> | <b>Fluid Mechanics And Fluid Machines Laboratory</b> |                     |                     |
| <b>Course Code</b>  | <b>24ME504</b>                                       | <b>LTPC</b>         | <b>0-0-2-1</b>      |
| <b>Exam</b>         | <b>03 Hours</b>                                      | <b>Hours / Week</b> | <b>02</b>           |
| <b>SEE</b>          | <b>50 Marks</b>                                      | <b>Total hours</b>  | <b>28P+02ABL=30</b> |

**Prerequisites:** Fluid Mechanics and Fluid Machines

**Course objectives:** To provide students with the necessary skills to conduct experiments, collect data, perform analysis and interpret results to draw valid conclusions through standard test procedures to calibrate the fluid flow measuring devices and to evaluate performance of hydraulic machines.

**Course Outcomes (COs)** {with mapping shown against the **Program Outcomes (POs)**}

Upon completion of the course, students shall be able to:

| <b>COs</b> | <b>Statement</b>                                                                                                  | <b>POs</b> | <b>PSOs</b> |
|------------|-------------------------------------------------------------------------------------------------------------------|------------|-------------|
| 1.         | Demonstrate& evaluate the losses through the pipes and the use of flow measuring devices.                         | 1,2,3,8,9  | -           |
| 2.         | Demonstrate the impulse-momentum principle to evaluate the hydrodynamic force exerted on a body by impact of jet. | 1,2,3,8,9  | -           |
| 3.         | Evaluate the performance parameters of hydraulic turbines and pumps.                                              | 1,2,3,8,9  | -           |

**Course Contents:**

**PART – A**

1. Determination of coefficient of friction of flow in a pipe.
2. Determination of minor losses in flow through pipes.
3. Experiments on flow measuring devices
  - a) Orifice plate
  - b) Venturi-meter
4. Flow through notches
5. Impact of jets on vanes

**PART – B**

6. Performance tests on Turbines
  - a) Pelton Wheel
  - b) Francis Turbine
  - c) Kaplan turbine
7. Performance tests on pumps
  - a) Centrifugal pump
  - b) Reciprocating Pump.

**SEE Scheme:**

|        |                                             |          |
|--------|---------------------------------------------|----------|
| 1.     | One experiment from either 1 to 5           | 15 Marks |
| 2.     | Any one performance test either from 6 or 7 | 25 Marks |
| 3.     | Viva Voce                                   | 10 Marks |
| Total: |                                             | 50 Marks |



**Teaching - Learning – Evaluation Scheme:**

| Sl. No                                 | Teaching and Learning Method        | No. of Hours/Week | No. of Weeks | Hours/ Semester |
|----------------------------------------|-------------------------------------|-------------------|--------------|-----------------|
| 1                                      | Class Room Teaching & Learning      | -                 | -            | -               |
| 2                                      | Practical                           | 2                 | 14           | 28              |
| 2                                      | Student Study Hours – Self Learning | -                 | -            | -               |
| 3                                      | Evaluation of Learning Process      | -                 | -            | -               |
| 4                                      | Activity Based Learning (ABL)       | -                 | -            | 02              |
| <b>Total Learning Hours / Semester</b> |                                     |                   |              | <b>30</b>       |

**Activity Based Learning (02 Hours)**

**ABL:** 1) To. Compare the coefficient of impact of Jet for different types of Vanes and Nozzles  
 2) To measure coefficient of discharge for Rectangular and Square notches  
 3) To measure the energy losses due to leakage in the pump (Pump losses)  
 4) To calibrate various flow measuring devices **(02Hrs)**

**Course Articulation Matrix**

| Course Outcomes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      |      |      |
|-----------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| COs             | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1             | 3                      | 3   | 3   |     |     |     |     | 1   | 2   |      |      |      |      |
| CO2             | 3                      | 3   | 3   |     |     |     |     | 1   | 2   |      |      |      |      |
| CO3             | 3                      | 3   | 3   |     |     |     |     | 1   | 2   |      |      |      |      |

|                     |                                             |                     |                     |
|---------------------|---------------------------------------------|---------------------|---------------------|
| <b>Course Title</b> | <b>CNC PROGRAMMING AND 3-D PRINTING LAB</b> |                     |                     |
| <b>Course Code</b>  | <b>24ME505</b>                              | <b>LTPC</b>         | <b>0-0-2-1</b>      |
| <b>Exam</b>         | <b>3 Hours</b>                              | <b>Hours / Week</b> | <b>02</b>           |
| <b>SEE</b>          | <b>50 Marks</b>                             | <b>Total hours</b>  | <b>28P+02ABL=30</b> |

**Course Objective:**

To provide students with hands-on experience in modern digital manufacturing technologies, specifically CNC machines and 3D printing

**Course Outcomes:**

Upon completion of the course, students shall be able to:

| # | Course Outcomes                                                                    | Mapping to POs | Mapping to PSOs |
|---|------------------------------------------------------------------------------------|----------------|-----------------|
| 1 | explain the basic concepts of computer numerical control & 3D-printing technology. | 1, 5           | 2               |
| 2 | Simulate CNC machining operations using CAM packages                               | 1, 5, 8        | 2               |
| 3 | Prepare components using 3D-printing technology                                    | 1, 3, 5, 8     | 1, 2            |

**Contents:**

Fundamentals of Machining, Fundamentals of Numerical Control, Elements of CNC System, Design Considerations of CNC Machine Tools, CNC Tooling, Automatic Tool Changers, Tool Magazines, Work Holding, Incremental and Absolute Systems of Programming, G-codes & M-codes, Machine Control Panel, Work Offset.

| Exp No. | EXPERIMENT NAME                                                                                                                                                                                   | COs | Pos        | Level |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|------------|-------|
| 1.      | Simulation of work offset on CNC simulator.                                                                                                                                                       | 1   | 1, 5       | 2     |
| 2.      | Simulation of part program to perform Facing operation using SinuTrain.                                                                                                                           | 2   | 1, 5       | 3     |
| 3.      | Simulation of part program to perform Facing & Turning operation using SinuTrain.                                                                                                                 | 2   | 1, 5       | 3     |
| 4.      | Simulation of part program to perform Step Turning operation using SinuTrain.                                                                                                                     | 2   | 1, 5       | 3     |
| 5.      | Simulation of part program to perform Taper Turning & Fillet operation using SinuTrain.                                                                                                           | 2   | 1, 5       | 3     |
| 6.      | Simulation of part program to perform Thread Cutting & Grooving operation using SinuTrain.                                                                                                        | 2   | 1, 5       | 3     |
| 7.      | Simulation of part program to perform milling operation using CNC simulator.                                                                                                                      | 2   | 1, 5       | 3     |
| 8.      | Generation and simulation of part programs to perform milling operation using CAM packages.                                                                                                       | 2   | 1, 5       | 3     |
| 9.      | Simple 3D Printing Model: Creating Simple 3D model in CAD software and printing the model using 3D Printer.                                                                                       | 3   | 1, 3, 5, 8 | 3     |
| 10.     | Assembly Model: Creating a 3D CAD assembly model containing four or more parts (example: Tailstock, screw jack, Plumber block, etc.) and print the model using 3D Printer and Check the assembly. | 3   | 1, 3, 5    | 3     |
| 11.     | Model-1: Preparing a model using CNC turning center (CNC Lathe) as per                                                                                                                            | 1   | 1,         | 3     |

|     |                                                                                                                                                             |   |         |   |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---------|---|
|     | given dimensions by performing facing, turning, step turning and taper turning operations                                                                   |   | 5, 8    |   |
| 12. | Model-2: Preparing a model using CNC machining center (CNC Milling Machine) as per given dimensions by performing pocket milling or face milling operations | 1 | 1, 5, 8 | 3 |

### **Scheme of Evaluation**

| Evaluation modules                          |  | Marks     |
|---------------------------------------------|--|-----------|
| Conduction of experiments from 1 to 10      |  | 10        |
| Preparation of Model using CNC              |  | 10        |
| Record writing                              |  | 10        |
| Test                                        |  | 20        |
| <b>Continuous internal Evaluation (CIE)</b> |  | <b>50</b> |
| <b>Semester End Examination</b>             |  |           |
| 1. One experiment from 3 to 8               |  | 20        |
| 2. One experiment from 9 to 10              |  | 20        |
| 3. Viva-Voce                                |  | 10        |
| <b>SEE</b>                                  |  | <b>50</b> |

### **Teaching -Learning–Evaluation Scheme:**

| Sl. No                                | Teaching and Learning Method       | No. of Hours/Week | No. of Weeks | Hours/ Semester |
|---------------------------------------|------------------------------------|-------------------|--------------|-----------------|
| 1                                     | Class Room Teaching & Learning     | 1                 | 4            | 04              |
| 2                                     | Practical                          | 2                 | 11           | 22              |
| 2                                     | Student Study Hours– Self-Learning | -                 | -            | -               |
| 3                                     | Evaluation of Learning Process     | 2                 | 1            | 02              |
| 4                                     | Activity Based Learning (ABL)      | -                 | -            | 02              |
| <b>Total Learning Hours/ Semester</b> |                                    |                   |              | <b>30</b>       |

### **Activity Based Learning(02 Hours)**

- 3D Modelling of a conceptual solution to the chosen problem.

### **Course Articulation Matrix**

| Course Outcomes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      |      |      |      |
|-----------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
|                 | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1             | 3                      |     |     |     | 2   |     |     |     |     |      |      |      |      | 2    |
| CO2             | 2                      |     |     |     | 3   |     |     | 1   |     |      |      |      |      | 3    |
| CO3             | 2                      |     | 2   |     | 3   |     |     | 1   |     |      |      |      |      | 3    |

|                     |                     |                     |                     |
|---------------------|---------------------|---------------------|---------------------|
| <b>Course Title</b> | <b>MECHATRONICS</b> |                     |                     |
| <b>Course Code</b>  | <b>23ME551</b>      | <b>LTPC</b>         | <b>3-0-0-3</b>      |
| <b>Exam</b>         | <b>03 Hours</b>     | <b>Hours / Week</b> | <b>03</b>           |
| <b>SEE</b>          | <b>100 Marks</b>    | <b>Total hours</b>  | <b>42L+48ABL=90</b> |

### Course Objective:

To impart knowledge of Microprocessors, Microcontrollers, PLCs and their role in Mechatronics systems. To introduce the students, the fundamentals of interdisciplinary engineering components and their integration in Mechatronics systems design approach.

### Course Outcomes (COs)

Upon completion of the course, students shall be able to:

| # | Course Outcomes                                                                           | Mapping to POs | Mapping to PSOs |
|---|-------------------------------------------------------------------------------------------|----------------|-----------------|
| 1 | Interpret the basic principles of Microprocessor, Micro controller and their applications | 1, 2           | -               |
| 2 | Interpret the basic principles of Microprocessor, Microcontroller and their applications  | 1, 3           | -               |
| 3 | design digitally controlled Mechatronics and PLC system for industrial process automation | 3, 5           | -               |

### Course contents:

| Module -1                                                                                                                                                                                                                                                                                                                                  | 10 Hrs. |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| <b>Introduction to Microprocessors:</b> Evolution of Microprocessor, organization of Microprocessor based system. Memory - Flip-Flop as a storage element. 8085 Microprocessor Instruction set Instruction classification. Architecture of 8085 Microprocessor. Instruction fetch operation. Microprocessor communication and bus timings. |         |
| <b>Microcontrollers-</b> Architecture of 8051 Microcontroller, selection factors. Comparison of Microprocessor and Microcontroller. Microchip Microcontrollers. Interfacing and Applications                                                                                                                                               |         |
| Module- 2                                                                                                                                                                                                                                                                                                                                  | 10 Hrs. |
| <b>Signal conditioning and Actuation systems</b> – Analog and Digital signals – Analogue to Digital Conversion (ADC), Digital to Analogue(DAC), Data acquisition systems. Actuators: Encoders, D. C. Motors, A. C. Motors, Stepper motors.                                                                                                 |         |
| <b>Mechatronics:</b> Introduction, Role of Various Engineering disciplines in Mechatronics, The Design process, Systems, Measurement systems, Control systems, Microprocessor based controllers.                                                                                                                                           |         |
| Module- 3                                                                                                                                                                                                                                                                                                                                  | 10 Hrs. |
| <b>Introduction to PLC:</b> Introduction, Basic PLC structure, Input/output processing, Introduction to Programming of PLCs, General PLC Programming procedures, for process control. PLC Timer and Counter functions, Simple Ladder Logic Programs using above PLC functional elements for automatic industrial process controls          |         |
| Module- 4                                                                                                                                                                                                                                                                                                                                  | 10 Hrs. |
| <b>Design of Mechatronics Systems:</b> Mechatronics System Case studies, <b>Design Solutions for Autotronics;</b> Car engine Management systems, Windscreen Wiper Mechanism Engine, Temperature Measurement, Antilock or Antiskid Device, Air Bag Deployment System etc.                                                                   |         |
| <b>Avionics:</b> Aircraft Engine Control, Cockpit Instrumentation etc. Automatic Camera System, Pick and place robot, Engine management system etc.                                                                                                                                                                                        |         |
| <b>MEMS and Microsystems:</b> overview of Micro manufacturing, Introduction to Artificial Intelligence.                                                                                                                                                                                                                                    |         |

**Self- Study Component:**

1. Sensor Networks in Mechatronics
2. Mechatronics in Biomedical Engineering
3. Autonomous Robots using Mechatronics
4. Mechatronics in Agriculture: Opportunities and Challenges
5. Networking PLCs: Levels of Industrial control, Types of Networking,
6. Network communications, PLC and Internet, Cell control by PLC Networks.

**Activity:**

1. Introduction to programmable open-source microcontroller board - Introduction to Arduino IDE- features, IDE overview. Programming concepts, Concept of GPIO in programmable open-source microcontroller board, digital input and output. Peripheral Interface
2. PLC in automation and its applications

**Text Book**

1. William Bolton, Mechatronics, Sixth Edition, Pearson, ISBN-9788131732533
2. John W. Webb and Ronald A. Reis, Programmable Logic Controllers: Principles and Applications, Fifth Edition, Pearson, 2015, ISBN-13 978-9332555129

**Reference Books:**

1. Aditya P. Mathur, "Introduction to Microprocessors", THM 3rd edition, 2000, ISBN\_0- 07-460222-5
2. Stamatios Manesis & George Nikolakopoulos, Introduction to Industrial Automation, CRC Press, 2018, ISBN: 978-1-4987-0540-0
3. Hugh Jack, Automating Manufacturing Systems with PLCs, Publisher: Lulu.com (September 12, 2010); eBook (Creative Commons Licensed)
4. M D Singh and J G Joshi, Mechatronics, Prentice-Hall-India, ISBN-81-203-2986

**Teaching -Learning– Evaluation Scheme:**

| Sl.No                                | Teaching and Learning Method        | No. of Hours/ Week | No. of Weeks | Hours/ Semester |
|--------------------------------------|-------------------------------------|--------------------|--------------|-----------------|
| 1                                    | Class Room Teaching & Learning      | 03                 | 14           | 42              |
| 2                                    | Integrated Lab Component            |                    |              |                 |
| 3                                    | Student Study Hours – Self Learning | 01                 | 14           | 14              |
| 4                                    | Tutorial Component                  |                    |              |                 |
| 5                                    | Activity Based Learning (ABL 1&2)   | 02                 | 14           | 28              |
| 6                                    | Evaluation of Learning Process      | -                  | -            | 06              |
| <b>Total Learning Hours/Semester</b> |                                     |                    |              | <b>90</b>       |

**Proposed Assessment Plan (for 50marks of CIE):**

| <b>Tool</b>            | <b>Remarks</b>                                                                                                                   | <b>Marks</b> |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>CIE</b>             | Three CIEs conducted for 20 marks each and reduced to 10marks                                                                    | 30           |
| <b>ABL (1 &amp; 2)</b> | Presentation on the selected topics from the syllabus (ABL1) and Demonstration of a Working Model related to the syllabus (ABL2) | 20           |
| <b>Total</b>           |                                                                                                                                  | <b>50</b>    |

**Evaluation of Learning Process (7Hours)**

| <b>Type of Evaluation</b> | <b>Hours</b> |
|---------------------------|--------------|
| CIE (1, 2 & 3)            | 03           |
| ABL 1                     | 02           |
| ABL 2                     | 01           |
| <b>Total</b>              | <b>06</b>    |

**Course Articulation Matrix**

| <b>Course Outcomes</b> | <b>Program Outcomes [POs]</b> |            |            |            |            |            |            |            |            |             |             |             |             |
|------------------------|-------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|-------------|-------------|
| <b>COs</b>             | <b>PO1</b>                    | <b>PO2</b> | <b>PO3</b> | <b>PO4</b> | <b>PO5</b> | <b>PO6</b> | <b>PO7</b> | <b>PO8</b> | <b>PO9</b> | <b>PO10</b> | <b>PO11</b> | <b>PSO1</b> | <b>PSO2</b> |
| 1.                     | 3                             | 2          |            |            |            |            |            |            |            |             |             |             |             |
| 2.                     | 3                             |            | 2          |            |            |            |            |            |            |             |             |             |             |
| 3.                     |                               |            |            |            |            |            |            |            |            |             |             |             |             |
| 4.                     |                               | 3          |            |            | 2          |            |            |            |            |             |             |             |             |

| Course Title | Project Management |              |              |
|--------------|--------------------|--------------|--------------|
| Course Code  | 24ME552            | LTPC         | 3-0-0-3      |
| Exam         | 3 Hours            | Hours / Week | 03 Hours     |
| SEE          | 50Marks            | Total hours  | 42L+48ABL=90 |

### Course objectives:

To impart comprehensive understanding of how to plan, optimize and efficiently manage projects(ortasks) to implement products, services or developments.

Course Outcomes (COs) {with mapping shown against the Program Outcomes

(POs))Uponsuccessfulcompletionofthiscourse,thestudent shallbeableto

| # | Course Outcomes                                                                                                                               | Mapping to POs | Mapping to PSOs |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------|
| 1 | explain the fundamental principles of project management, organizational structures, and the roles and responsibilities of a project manager. | 1, 7, 8, 9, 10 | -               |
| 2 | describe the different methods and techniques used in project management.                                                                     | 1, 3, 8, 10    | -               |
| 3 | analyze the role of software effort estimation techniques in project management and conduct case study analysis of projects.                  | 1, 8, 9, 10    | -               |

### CourseContents:

| Module–I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 11 Hrs. |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| <b>IntroductiontoProjectManagement:</b> Conceptofprojectandprojectmanagement, characteristic features and classification of projects, phases of projectmanagement,selectionofprojectmanagersandtheir duties.<br><b>ProjectPlanningandEstimation:</b> Projectplanningsteps,objectivesandgoalsof theproject,Feasibilityreports, financing arrangements,preparationofcostestimation. 7's of project Management.                                                                                                                                                         |         |
| Module – II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 10 Hrs. |
| <b>OrganizingandStaffingtheProjectTeam:</b> Authoritiesofprojectmanager,organizational structure and types, accountability in project execution, contracts, 3'R'sofcontracting, tenderingprocessandselection of contractors, team building.<br><b>ProjectSchedulingToolsandTechniques:</b> Ganttchart,barchartforcombined activities, Critical path method (CPM) and Project evaluation and review technique(PERT), Numericalproblems.                                                                                                                               |         |
| Module–III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 11 Hrs. |
| <b>Project Direction, Coordination and Control:</b> Project direction, communication in a project, PMIS,projectcoordinationandschedulecontrol & cost control.<br>Resource allocation, Resource loading and leveling, Constrained resource scheduling. Risk management:Introduction,RiskManagement Process, Monitoring andControlRisks. <b>ISO</b> and concepts of total quality management and six sigma.<br><b>PerformanceMeasuresinProjectManagement:</b> Performanceindicators,performanceimprovement, projectmanagement environment and Project Control Process. |         |

| <b>Module–IV</b>                                                                                                                                                                                                                                                       | <b>10 Hrs.</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Software project management:</b> Introduction, computerized project management, managing software projects, overview of capability maturity model (CMM), project management and the CMM. <b>Casestudiesonprojectmanagement:</b> Modern cases in project management. |                |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>TextBook:</b> <ol style="list-style-type: none"> <li>1. Project Management a System approach to planning Scheduling &amp; Controlling - Harold Kerzner, 10th edition 2009, John Wiley &amp; sons.</li> <li>2. Chaudhry S, Project Execution Plan - Plan for project Execution interaction, 2001</li> </ol>                                                                                                                                            |
| <b>ReferenceBooks:</b> <ol style="list-style-type: none"> <li>1. Software Project Management in Practice - Pankaj Jalote, Pearson education</li> <li>2. Fundamentals of Project Management: Rory Burke, 2010, Burke Publishing.</li> <li>3. Project planning scheduling &amp; control, James P. Lawis, Meo Publishing Company, 5th edition 2010.</li> <li>4. A Management Guide to PERT and CPM, WEIST &amp; LEVY - Eastern Economy PHI 2002.</li> </ol> |

### Teaching -Learning– Evaluation Scheme:

| Sl. No                                 | Teaching and Learning Method          | No. of Hours/ Week | No. of Weeks | Hours/ Semester |
|----------------------------------------|---------------------------------------|--------------------|--------------|-----------------|
| 1                                      | Class Room Teaching                   | 3                  | 14           | 42              |
| 2                                      | Integrated Lab Component              | -                  | -            | -               |
| 3                                      | Student Study Hours – Self Learning   | -                  | -            | -               |
| 4                                      | Tutorial component                    | -                  | -            | -               |
| 5                                      | Activity Based Learning (ABL1 & ABL2) | -                  | -            | 40              |
| 6                                      | Evaluation of Learning Process        | -                  | -            | 08              |
| <b>Total Learning Hours / Semester</b> |                                       |                    |              | <b>90</b>       |

### Assessment Plan (for 50marks of CIE):

| Tool             | Remarks                                                                                                                                                                                                                                                                                                                                                                                                     | Marks     |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| CIE              | Three CIEs conducted for 20 marks each and reduced to 10 marks                                                                                                                                                                                                                                                                                                                                              | 30        |
| Activity Details | Details of activities to be conducted<br>1) Details of activity 1 - Conduct quiz on each module and take the average marks. -- <b>05 Marks.</b><br>2) Details of activity 2 - The surprise test will be conducted from module 2/3. – <b>05 Marks.</b><br>3) Details of activity 3 – Conduct a case study on any project management example, prepare a report, and present their findings. - <b>10 Marks</b> | 20        |
| <b>Total</b>     |                                                                                                                                                                                                                                                                                                                                                                                                             | <b>50</b> |

### Activities Mapped to Modules:

| Module       | Activity Description                                                          | Hours     |
|--------------|-------------------------------------------------------------------------------|-----------|
| 1, 2 & 3     | Preparation for the quiz and surprise test.                                   | 08        |
| 4            | A case study on any project example, prepare of the report, and presentation. | 32        |
| <b>Total</b> |                                                                               | <b>40</b> |

### Evaluation of Learning Process (08 Hours)



| Type of Evaluation | Hours     |
|--------------------|-----------|
| Test (1, 2 and 3)  | 03        |
| Quiz               | 01        |
| Presentation       | 01        |
| Semester End Exam  | 03        |
| <b>Total</b>       | <b>08</b> |

### Course Articulation Matrix

| Course Outcomes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      | PSO's |      |
|-----------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|-------|------|
| COs             | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1  | PSO2 |
| <b>1</b>        | 3                      |     |     |     |     |     | 2   | 2   | 2   | 2    |      |       |      |
| <b>2</b>        | 3                      |     | 2   |     |     |     |     | 3   |     | 2    |      |       |      |
| <b>3</b>        | 3                      |     |     |     |     |     |     | 3   | 3   | 3    |      |       |      |

|                     |                                       |                     |                     |
|---------------------|---------------------------------------|---------------------|---------------------|
| <b>Course Title</b> | <b>Quality Control And Management</b> |                     |                     |
| <b>Course Code</b>  | <b>24ME553</b>                        | <b>LTPC</b>         | <b>3-0-0-3</b>      |
| <b>Exam</b>         | <b>3 Hours</b>                        | <b>Hours / Week</b> | <b>03</b>           |
| <b>SEE</b>          | <b>50Marks</b>                        | <b>Total hours</b>  | <b>42L+48ABL=90</b> |

**Course Objective:** To make students apply quality management concepts and statistical process control techniques to improve quality.

### Course Outcomes (COs)

Upon completion of the course, students shall be able to:

| # | Course Outcomes                                                               | Mapping to POs | Mapping to PSOs |
|---|-------------------------------------------------------------------------------|----------------|-----------------|
| 1 | Explain the basic concepts of quality management                              | 1,2,6,7,8      | -               |
| 2 | apply statistical process control techniques to control the quality standards | 2, 8           | -               |
| 3 | Develop and interpret control charts                                          | 2              | -               |

### Course contents:

|                                                                                                                                                                                                                                                                                                                                                                                                                 |                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Module -1</b>                                                                                                                                                                                                                                                                                                                                                                                                | <b>10 Hrs.</b> |
| <b>Quality Management:</b> Introduction, basic approach, TQM framework, different dimensions of quality, historical review and Deming's philosophy. Continuous Quality Improvement Tools: PDCA cycle, Juran quality trilogy, Kaizen, benchmarking, steps involved in benchmarking process, 5S, 3M and poka-yoke.                                                                                                |                |
| <b>Module- 2</b>                                                                                                                                                                                                                                                                                                                                                                                                | <b>10 Hrs.</b> |
| <b>Statistical Process Control:</b> Introduction, pareto diagram, process flow charts, cause and effect diagram. Statistical fundamentals: Six sigma, process capability, chance and assignable causes of quality variations, statistical basis for the control charts.                                                                                                                                         |                |
| <b>Module- 3</b>                                                                                                                                                                                                                                                                                                                                                                                                | <b>10 Hrs.</b> |
| <b>Control charts for variables:</b> Development and interpretation of $\bar{X}$ -bar & R-charts: Process Capability Estimating, Process capability ratio, Fraction of nonconforming, Revision of Control Limits and Center Lines, Control Limits, Specification Limits and Natural Tolerance Limits. Development of $\bar{X}$ -bar & $\sigma$ charts.                                                          |                |
| <b>Module- 4</b>                                                                                                                                                                                                                                                                                                                                                                                                | <b>10 Hrs.</b> |
| <b>Control Charts for Attributes:</b> Introduction, control charts for fraction defectives, development of control charts for constant sample size & variable sample sizes, and control charts for defects. Guidelines for implementing control charts, construction, applications and interpretation of p – chart, np – chart and C – chart. <b>Acceptance Sampling:</b> Introduction, Types of Sampling Plan. |                |

### Self-Study Component:

Quality management systems: Quality management principles, development of ISO 9000 series standards, ISO 9001:20015 requirements, implementation of ISO 9001:20015, comparison between ISO 9001:20015 and ISO 9001:2000, documentation, certification, benefits of ISO certification.

Environmental management systems: Importance of ISO standards, ISO standards for different sectors, environmental management systems, ISO 14000 series standards, concepts of ISO 14001, requirements of ISO 14001:2015, implementation of ISO 14001:2015, benefits of environmental management system, documentation and certification.

**Text Books:**

1. Dale H. Besterfield, Total Quality Management, Pearson Education India, 2018. ISBN: 9789353066314, Fifth Edition
2. Douglas C. Montgomery, Introduction to Statistical Quality Control, John Wiley & Sons, Inc. 6<sup>th</sup> edition. ISBN: 978-0-470-16992-6

**Reference Books:**

1. M. Zairi, Publisher, Total Quality Management for Engineers, Woodhead Publishing, ISBN: 1855730243
2. Manohar Mahajan, Statistical Quality Control, Dhanpat Rai and Sons, New Delhi, 2018.
3. E.L. Grant, and R.S. Leavenworth, Statistical Quality Control, Seventh Edition, TMH, New Delhi, 2016. ISBN: 0-07-114248-7

**Teaching -Learning– Evaluation Scheme:**

| Sl.No                                | Teaching and Learning Method          | No. of Hours/ Week | No. of Weeks | Hours/ Semester |
|--------------------------------------|---------------------------------------|--------------------|--------------|-----------------|
| 1                                    | ClassRoom Teaching & Learning         | 3                  | 14           | 42              |
| 2                                    | Integrated Lab Component              | -                  | -            | -               |
| 3                                    | Student Study Hours – Self Learning   | -                  | -            | 6               |
| 4                                    | Tutorial Component                    | -                  | -            | -               |
| 5                                    | Activity Based Learning (ABL1 & ABL2) | -                  | -            | 35              |
| 6                                    | Evaluation of Learning Process        | -                  | -            | 07              |
| <b>Total Learning Hours/Semester</b> |                                       |                    |              | <b>90</b>       |

**Proposed Assessment Plan (for 50 marks of CIE):**

| Tool             | Remarks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Marks |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| CIE              | Three CIEs conducted for 20 marks each and reduced to 10 marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 30    |
| Activity Details | Details of activities to be conducted: <ol style="list-style-type: none"> <li>1. Presentation based on implementation of 5S</li> <li>2. Presentation based on drawing cause and effect diagram for the chosen problem</li> <li>3. Case study on improving quality through the application of SQC techniques.</li> <li>4. Presentation based on the topics listed in self-study component</li> <li>5. Review of recent research articles related to quality control</li> </ol> Students can choose any two activities. Each activity carries 10 marks. | 20    |

**Activities Mapped to Modules:**

| Module       | Activity Description                                                          | Hours     |
|--------------|-------------------------------------------------------------------------------|-----------|
| 1            | Presentation based on implementation of 5S                                    | 9         |
| 2            | Presentation based on drawing cause and effect diagram for the chosen problem | 9         |
| 3 & 4        | Case study on improving quality through the application of SQC techniques.    | 9         |
| 1, 2, 3 & 4  | Review of recent research articles related to quality control                 | 9         |
| <b>Total</b> |                                                                               | <b>36</b> |

### Evaluation of Learning Process (6 Hours)

| Type of Evaluation | Hours    |
|--------------------|----------|
| CIE                | 3        |
| Activity           | 1        |
| SEE                | 3        |
| <b>Total</b>       | <b>7</b> |

## Course Articulation Matrix

[illegible]

|                     |                              |                     |                     |
|---------------------|------------------------------|---------------------|---------------------|
| <b>Course Title</b> | <b>PRINCIPLES OF CAD/CAM</b> |                     |                     |
| <b>Course Code</b>  | <b>23ME554</b>               | <b>LTPC</b>         | <b>3-0-0-3</b>      |
| <b>Exam</b>         | <b>3 Hours</b>               | <b>Hours / Week</b> | <b>03 Hours</b>     |
| <b>SEE</b>          | <b>50Marks</b>               | <b>Total hours</b>  | <b>40L+50ABL=90</b> |

### CourseObjective:

To make students apply the concepts of CAD to develop models of machine components andCAMto obtain machined components.

Course **Outcomes (COs)** {with mapping shown against the **Program Outcomes (POs)**}

**Upon successful completion ofthis course, studentsshall beableto:**

| <b>C<br/>O</b> | <b>Statement's</b>                                                                                                                                | <b>POs</b> | <b>PS<br/>Os</b> |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------|------------|------------------|
| 1              | Acquire the basic concepts of CAD/CAM with their software requirementsanddifferentgeometricalmodelingtechniquetodevelopmodelsofma chinecomponents | 1,3,5      | 2                |
| 2              | IllustratetheconceptsofCNCandCAMtowritepartprogramsforvarious machining operationsandobtainmachinedcomponents                                     | 1,2,5,9    | -                |
| 3              | Discusstheadvanced manufacturing approachestoensureoptimum utilizationofavailable resources                                                       | 1,2        | -                |

### COURSECONTENTS:

| <b>Module-I</b>                                                                                                                                                                                                                                                                                                                                               | <b>10Hrs.</b>  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Computer Aided Design:</b> Introduction of CAD and CAM tools, Product Life Cycle. Softwareconfiguration for graphic system, Functions of graphic package. <b>Principles of ComputerGraphics:</b> Graphic primitives, Database Co-ordinate systems, 2-D Transformations of geometry,Displayfunctions like Window, Viewport, viewingand clipping operations. |                |
| <b>Module-2</b>                                                                                                                                                                                                                                                                                                                                               | <b>10 Hrs.</b> |
| <b>Modeling Techniques:</b> Geometrical Modeling and its importance, modeling types: solid,wireframe& surface modeling, approaches. <b>Mathematical representations of Surfaces:</b> Surface entities, Parametric representations of Analytical and Synthetic surfaces (Bezier and B-spline).                                                                 |                |
| <b>Module-3</b>                                                                                                                                                                                                                                                                                                                                               | <b>10 Hrs.</b> |
| <b>Computer Aided Manufacturing:</b> Basic components of NC, NC coordinate systems, NCmotioncontrolsystems,CNC and DNC features.<br><b>CNC programming Techniques:</b> Part programming fundamentals, Preparatory andMiscellaneousfunctions, Typical examplesofDrillingandMillingoperationsthroughmanualpartprogramming methods.                              |                |
| <b>Module-4</b>                                                                                                                                                                                                                                                                                                                                               | <b>10 Hrs.</b> |
| <b>Advanced Manufacturing Approaches:</b> Rapid prototyping and its processes, SL, LTP,Flexible Manufacturing System, Reconfigurable Manufacturing Systems, Reverse Engineering,Leanmanufacturing.                                                                                                                                                            |                |

**TextBooks:**

1. Michel P Groover & Emory W Zimmeres, JR, CAD & CAM, TMH, 2<sup>nd</sup> Edition, 2004, ISBN-81-203-04020-0.
2. Ibrahim Zeid, S.Subramanya V. Raju, CAD & CA Theory and practice, TMH, 2<sup>nd</sup> Edition, 2010, ISBN-0-07-463991-9.

**Reference Books:**

1. Dr.SadhuSingh, Computer Aided Design and Manufacturing, Khanna publishers, 2011, ISBN: 81-7409-069-3
2. P.N. Rao, "CAD & CAM Principles & Application", TMH, 2<sup>nd</sup> Edition, 2004, ISBN-13-978-81-2336-8.

**Teaching -Learning– Evaluation Scheme:**

| Sl.No.                                 | Teaching and Learning Method          | No. of Hours/ Week | No. of Weeks | Hours/ Semester |
|----------------------------------------|---------------------------------------|--------------------|--------------|-----------------|
| 1                                      | Class Room Teaching                   | 3                  | 14           | 40              |
| 2                                      | Integrated Lab Component              | -                  | -            | -               |
| 3                                      | Student Study Hours – Self Learning   | -                  | -            | -               |
| 4                                      | Tutorial component                    | -                  | -            | -               |
| 5                                      | Activity Based Learning (ABL1 & ABL2) | -                  | -            | 42              |
| 6                                      | Evaluation of Learning Process        | -                  | -            | 08              |
| <b>Total Learning Hours / Semester</b> |                                       |                    |              | <b>90</b>       |

**Proposed Assessment Plan (for 50marks of CIE):**

| Tool             | Remarks                                                                                                                                                                                                                                                                                    | Marks     |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| CIE              | Three CIEs conducted for 20marks each and reduced to 10 marks                                                                                                                                                                                                                              | 30        |
| Activity Details | Details of activities to be conducted<br>1) Creating 3D CAD Model (Cavity based model) using CAD Tool. (05 Marks)<br>2) Generating CNC Part program using CAM Tool for the 3D cavity-based model. (10 Marks)<br>3) Building prototype of 3D Cavity based model using 3D Printer (05 Marks) | 20        |
| <b>Total</b>     |                                                                                                                                                                                                                                                                                            | <b>50</b> |

**Activities Mapped to Modules:**

| Module       | Activity Description                                | Hours     |
|--------------|-----------------------------------------------------|-----------|
| 1 & 2        | Practice and preparation of 3D Model using CAD tool | 11        |
| 3            | Generating CNC Part program using CAM Tool.         | 11        |
| 4            | Building prototype of 3D Model using 3D Printer     | 20        |
| <b>Total</b> |                                                     | <b>42</b> |

### Evaluation of Learning Process (10 Hours)

| Type of Evaluation             | Hours     |
|--------------------------------|-----------|
| Test (1, 2 and 3)              | 03        |
| Building prototype of 3D Model | 02        |
| Semester End Exam              | 03        |
| <b>Total</b>                   | <b>10</b> |

| Course Outcomes | Program Outcomes [PO's] |     |     |     |     |     |     |     |     |      |      | PSO's |      |
|-----------------|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|-------|------|
| COs             | PO1                     | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1  | PSO2 |
| CO1             | 3                       | -   | 2   | -   | 2   | -   | -   | -   | -   | -    | -    | -     | 2    |
| CO2             | 3                       | 2   | -   | -   | 2   | -   | -   | -   | 2   |      | -    | -     | 2    |
| CO3             | 3                       | 2   |     |     |     |     |     |     |     |      |      |       |      |

## MINI PROJECT

24ME506

LTPC: 0-0-4-2

Exam Hours: 3

Hours/ Week: 04

CIE: 100 Marks

Total hours: 40

**Course Objectives:** To take part in a group to demonstrate the acquired skill & knowledge gained to identify, formulate, analyze, evaluate and to provide meaningful engineering solutions to Industrial/societal needs.

**Course Outcomes (COs){with mapping shown against the Program Outcomes(POs)} Upon successful completion of this course, the student shall be able to:**

| #  | Course Outcomes                                                                       | Mapping to POs     | Mapping to PSOs |
|----|---------------------------------------------------------------------------------------|--------------------|-----------------|
| 1. | Identify thrust areas in field of Mechanical or allied areas of Engineering           | 1, 2, 4, 6         | -               |
| 2. | Generate and implement innovative ideas for social benefit                            | 1, 2, 4, 5,6       | -               |
| 3. | Conducting preliminary Analysis /Modeling /Simulation /Experiment /Design/Feasibility | 4, 5, 6, 7,8, 9,10 | -               |
| 4. | Prepare a report on the Study conducted for presentation                              | 9                  | -               |

The objective of Mini Project is to enable the student to take up investigative study in the broad field of Mechanical Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the department on an individual basis or two/three students in a group, under the guidance of a supervisor. This is expected to provide a good initiation for the student(s) in R&D work. The mini project is designed to develop practical ability and knowledge about tools/techniques to solve the actual problems related to industry, academic institutions or similar area. The mini project should be undertaken preferably by a group of minimum two and maximum four students who will jointly work together and implement the project. Students can take up any application level/fabrication level/ experimental design / implementation tasks of relatively minor intensity and scope as compared to the major project, pertaining to a relevant domain of study. Projects can be chosen either from the list provided by the faculty or in the field of interest of the student. At the end of each phase, presentation and demonstration of the project should be conducted, which will be evaluated based on the rubrics set by the department under the committee of HOD, one professor, one Associate professor and one Assistant Professor. A detailed project report duly approved by the guide in the prescribed format should be submitted by the student for final evaluation.

Project Stage 1 – Team Formation, Literature survey, defining problems and objectives

Project Stage 2 – Methodology description

Project Stage 3 – Final prototype/working model presentation along with a report in the prescribed format.

The evaluation of the project phases shall be carried out by the evaluation committee comprising of project guide & other faculty members. The committee will be constituted by the mini project coordinators in consultation with the Head of the department.



## SCHEME/RUBRICS OF EVALUATION

| Examination | Maximum marks | Minimum marks to qualify |
|-------------|---------------|--------------------------|
| CIE         | 100           | 40                       |

| Criteria                                           | Low(2-8)                                                                          | Medium(10-14)                                                                            | High(16-20)                                                                                                                          | Max Marks | COs | POs            |
|----------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-----------|-----|----------------|
| Identification of the Problem (20 Marks)           | Incomplete or improper problem identification                                     | Partially complete with some issues.                                                     | Proper identification of problem                                                                                                     | 20        | 1   | 1,2,4,6        |
| Innovativeness of the Project (20 Marks)           | Lacks innovation or creative approaches.                                          | Somewhat innovative, but lacks originality.                                              | Highly innovative with creative problem-solving.                                                                                     | 20        | 2   | 1,2,4,5,6      |
| Design /Experimentation & working Model (40 Marks) | Poor Design and Experimentation process (4-16 marks)                              | Adequate design and experimentation but needs improvement (20-28 marks)                  | Proper design and Experimentation are well planned (32-40 marks)                                                                     | 40        | 3   | 4,5,6,7,8,9,10 |
| Report & presentation (20 Marks)                   | Unclear or unorganized report /presentation, Unable to respond or unclear answers | Adequate report/ presentation but needs improvement, Adequate responses With minor gaps. | Well-written, clear, and technically sound. Clear, organized, and well-executed Presentation, confident, and knowledgeable responses | 20        | 4   | 9              |

| Course Outcomes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      |      |      |
|-----------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| COs             | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1             | 2                      | 3   |     | 3   |     | 2   |     |     |     |      |      |      |      |
| CO2             | 2                      | 3   |     | 2   | 2   | 2   |     |     |     |      |      |      |      |
| CO3             |                        |     |     | 3   | 3   | 2   | 3   | 3   | 2   | 2    |      |      |      |
| CO4             |                        |     |     |     |     |     |     |     | 2   |      |      |      |      |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                             |                       |                         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|-----------------------|-------------------------|
| <b>Course Title</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>RESEARCH METHODOLOGY AND IPR</b>                                         |                       |                         |
| <b>Course Code</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>24RIP</b>                                                                | <b>(L-T-P)C</b>       | <b>(3-0-0) 3</b>        |
| <b>CIE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>50</b>                                                                   | <b>Hours/Week</b>     | <b>3</b>                |
| <b>SEE</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>50</b>                                                                   | <b>Total Hours</b>    | <b>42L + 48ABL = 90</b> |
| <b>Course Objective:</b> To understand research methodology, technical writing, and IPR concepts in engineering research.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                             |                       |                         |
| <b>Course Outcomes:</b> At the end of course, student will be able to:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                             |                       |                         |
| #                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>Course Outcomes</b>                                                      | <b>Mapping to POs</b> | <b>Mapping to PSOs</b>  |
| 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Carry out Literature Review and write technical paper                       | 2,3,4,8,12            | -                       |
| 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Describe the fundamentals of patent laws and the patent drafting procedure. | 6,8,10,12             | -                       |
| 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Elucidate the copyright laws and subject matters of copyright               | 6,8, 10,12            | -                       |
| <b>MODULE-1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                             |                       | <b>10 Hrs</b>           |
| <b>Introduction:</b> Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research. <b>Ethics in Engineering Research:</b> Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship.<br><b>Literature Review and Technical Reading,</b> New and Existing Knowledge, Analysis and Synthesis of Prior Art, Bibliographic Databases, Web of Science, Google and Google Scholar, Effective Search: The Way Forward, Introduction to Technical Reading Conceptualizing Research, Critical and Creative Reading.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                             |                       |                         |
| <b>MODULE-2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                             |                       | <b>10 Hrs</b>           |
| <b>Attributions and Citations:</b> Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions.<br><b>Technical Writing and Publishing :</b> Free Writing and Mining for Ideas, Attributes and Reasons of Technical Writing, Patent or Technical Paper?— The Choice, Writing Journal Paper :Structure and Approach : Title, Abstract, and Introduction, Methods, Results, and Discussions, Table, Figures, Acknowledgments, and Closures                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                             |                       |                         |
| <b>MODULE-3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                             |                       | <b>11Hrs</b>            |
| <b>Introduction To Intellectual Property:</b> Role of IP in the Economic and Cultural Development of the Society, IP Governance, IP as a Global Indicator of Innovation, Origin of IP, Major Amendments in IP Laws and Acts in India. <b>Patents:</b> Conditions for Obtaining a Patent Protection, To Patent or Not to Patent an Invention. Rights Associated with Patents. Enforcement of Patent Rights. Inventions Eligible for Patenting. Non- Patentable Matters. Patent Infringements.<br><b>Process of Patenting:</b> Prior Art Search. Choice of Application to be Filed. Patent Application Forms. Jurisdiction of Filing Patent Application. Publication. Pre-grant Opposition. Examination. Grant of a Patent. Validity of Patent Protection. Post-grant Opposition. DoI Need First to File a Patent in India. Patent Related Forms. Fee Structure. Types of Patent Applications.                                                                                                                                                                                                                                                                                                                     |                                                                             |                       |                         |
| <b>MODULE-4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                             |                       | <b>11Hrs</b>            |
| <b>Copyrights and Related Rights:</b> Classes of Copyrights. Criteria for Copyright. Ownership of Copyright. Copyrights of the Author. Copyright Infringements. Copyright Infringement is a Criminal Offence. Copyright Infringement is a Cognizable Offence. Copyrights and Internet. Non-Copyright Work. Copyright Registration. Judicial Powers of the Registrar of Copyrights. Fee Structure. Copyright Symbol. Validity of Copyright. Copyright Profile of India. Copyright and the word 'Publish'. Transfer of Copyrights to a Publisher. Copyrights and the Word 'Adaptation'. Copyrights and the Word 'Indian Work'. Joint Authorship. Copyright Society. Copyright Board. Copyright Enforcement Advisory Council (CEAC).<br><b>Trademarks:</b> Eligibility Criteria. Who Can Apply for a Trademark. Acts and Laws. Designation of Trademark Symbols. Classification of Trademarks. Registration of a Trademark is Not Compulsory. Validity of Trademark. Types of Trademark Registered in India. Trademark Registry. Process for Trademarks Registration.<br><b>Self study:</b> Case Studies on Patents. Case study of Curcuma (Turmeric) Patent, Case study of Neem Patent, IP Organizations in India. |                                                                             |                       |                         |

### Prescribed Text Books

| Sl. No | Book Title                       | Authors                                      | Edition         | Publisher                             | Year |
|--------|----------------------------------|----------------------------------------------|-----------------|---------------------------------------|------|
| 1      | Engineering Research Methodology | Dipankar Deb, Rajeeb Dey, Valentina E, Balas | -               | Springer                              | 2019 |
| 2      | Intellectual Property            | Prof. Rupinder Tewari, Ms. Mamta Bhardwa     | 6 <sup>th</sup> | Publication Bureau, Panjab University | 2021 |

### Reference Text Books:

| Sl. No | Book Title                     | Authors        | Edition         | Publisher                  | Year |
|--------|--------------------------------|----------------|-----------------|----------------------------|------|
| 1      | Research Methods for Engineers | David V. Thiel | -               | Cambridge University Press | 2014 |
| 2      | Intellectual Property Rights   | N.K. Acharya   | 8 <sup>th</sup> | Asia Law House             | 2021 |

### E Books and online course materials:

1. <https://s11nk.com/y4ggnaa>
2. <https://dst.gov.in/sites/default/files/E-BOOK%20IPR.pdf>

### Online Courses and Video Lectures:

1. <http://digimat.in/nptel/courses/video/127106227/L05.html>
2. [https://onlinecourses.swayam2.ac.in/e-learning/preview/aic25\\_ge09](https://onlinecourses.swayam2.ac.in/e-learning/preview/aic25_ge09)

### Teaching -Learning– Evaluation Scheme:

| Sl. No                          | Teaching and Learning Method        | No. of Hours/Week | No. of Weeks | Hours/ Semester |
|---------------------------------|-------------------------------------|-------------------|--------------|-----------------|
| 1                               | Class Room Teaching & Learning      | 3                 | 14           | 42              |
| 2                               | Student Study Hours – Self Learning | 1                 | 14           | 14              |
| 3                               | Evaluation of Learning Process      | -                 | -            | 07              |
| 4                               | Activity Based Learning (ABL)       | -                 | -            | 14+13=27        |
| Total Learning Hours / Semester |                                     |                   |              | 90              |

### Proposed Assessment Plan (50 marks):

| Tool             | Remarks                                                                                                                                                                                                                                                                     | Marks     |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| CIE              | Three CIEs conducted for 20 marks each and reduced to 10 marks                                                                                                                                                                                                              | 30        |
| Activity Details | Details of activities to be conducted<br>Activity 1: Students select any research topic and perform a literature review, identifying existing knowledge, synthesizing prior art, and compiling relevant citations leading to structured survey paper ready for publication. | 10        |
|                  | Activity 2: Students analyze real world case studies for legal issues and propose solutions to infringement cases.                                                                                                                                                          | 10        |
| <b>Total</b>     |                                                                                                                                                                                                                                                                             | <b>50</b> |

### Activity Based Learning (27 Hours)

|                                                                  |                                                       |           |
|------------------------------------------------------------------|-------------------------------------------------------|-----------|
| <b>ABL 1: Drafting survey paper (14 Hrs.)</b>                    |                                                       |           |
| Drafting survey paper                                            | Research Topic Selection                              | 02        |
|                                                                  | Literature review & Identifying existing knowledge    | 05        |
|                                                                  | Synthesizing prior art & compiling relevant citations | 04        |
|                                                                  | Presentation of structured paper                      | 03        |
| <b>ABL 1: Total</b>                                              |                                                       | <b>14</b> |
| <b>ABL 2: Students analyse real world case studies (13 Hrs.)</b> |                                                       |           |
| Real world case studies analysis                                 | Legal issues                                          | 04        |
|                                                                  | Propose solutions to infringement cases               | 04        |
|                                                                  | Presentation, demonstration, viva-voce                | 05        |
| <b>ABL 2: Total</b>                                              |                                                       | <b>13</b> |
| <b>ABL1 + ABL2: Total</b>                                        |                                                       | <b>27</b> |

### Evaluation of Learning Process (07 Hours)

| Type of Evaluation | Hours     |
|--------------------|-----------|
| CIE (1, 2 and 3)   | 03        |
| Activity (1 and 2) | 01        |
| Semester End Exam  | 03        |
| <b>Total</b>       | <b>07</b> |

### Course Articulation Matrix

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

| Course Title                                                                                                                                                                                                                                                             |                                                                                                                                                   | Environmental Studies                                 |                |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|----------------|-----------------|
| Course Code                                                                                                                                                                                                                                                              | 24EVS                                                                                                                                             | L-T-P                                                 | (0-0-2) 1      |                 |
| Exam                                                                                                                                                                                                                                                                     | 3 Hrs.                                                                                                                                            | Hours/Week                                            | 2              |                 |
| CIE                                                                                                                                                                                                                                                                      | 100 Marks                                                                                                                                         | Total Hours                                           | 20             |                 |
| <b>Course Outcomes:</b> At the end of the course, student will be able to:                                                                                                                                                                                               |                                                                                                                                                   |                                                       |                |                 |
| #                                                                                                                                                                                                                                                                        | Course Outcomes (CO)                                                                                                                              |                                                       | Mapping to POs |                 |
| 1.                                                                                                                                                                                                                                                                       | Acquire an awareness of sensitivity to the total environment and its allied problems.                                                             |                                                       | 7, 9           |                 |
| 2.                                                                                                                                                                                                                                                                       | Develop strong feelings of concern, sense of ethical responsibility for the environment and the motivation to act in protecting and improving it. |                                                       | 6,8            |                 |
| 3.                                                                                                                                                                                                                                                                       | Analyze and evaluate environmental measures in real world situations in terms of ecological, political, economic, societal and aesthetic factors. |                                                       | 6, 7,8, 9      |                 |
| <b>MODULE-1</b>                                                                                                                                                                                                                                                          |                                                                                                                                                   |                                                       | <b>5Hrs</b>    |                 |
| <b>Environment:</b> Definition, Ecosystem, Balanced ecosystem, Effects of human activities on environment Agriculture Housing Industry Mining and Transportation.                                                                                                        |                                                                                                                                                   |                                                       |                |                 |
| <b>MODULE-2</b>                                                                                                                                                                                                                                                          |                                                                                                                                                   |                                                       | <b>5 Hrs.</b>  |                 |
| <b>Natural Resources:</b> Water resources, Availability and Quality, Water borne diseases, Water induced diseases, Fluoride problem in drinking water. Mineral Resources - Forest Resources - Material Cycles - Carbon, Nitrogen and Sulphur Cycles.                     |                                                                                                                                                   |                                                       |                |                 |
| <b>MODULE-3</b>                                                                                                                                                                                                                                                          |                                                                                                                                                   |                                                       | <b>5Hrs</b>    |                 |
| <b>Pollution:</b> Effects of pollution - Water pollution - Air pollution Land pollution - Noise pollution.                                                                                                                                                               |                                                                                                                                                   |                                                       |                |                 |
| <b>MODULE-4</b>                                                                                                                                                                                                                                                          |                                                                                                                                                   |                                                       | <b>5 Hrs.</b>  |                 |
| <b>Current Environmental issues of importance:</b> Acid Rain, Ozone layer depletion - Population Growth, Climate change and Global warming. Environmental Impact Assessment and Sustainable Development Environmental Protection - Legal aspects. Water Act and Air Act. |                                                                                                                                                   |                                                       |                |                 |
| <b>Text Books:</b>                                                                                                                                                                                                                                                       |                                                                                                                                                   |                                                       |                |                 |
| 1. Environmental Studies - Dr. D.L Manjunath, Pearson Education -2006                                                                                                                                                                                                    |                                                                                                                                                   |                                                       |                |                 |
| 2. Environmental Studies - Dr. S. M. Prakash - Elite Publishers – 2006                                                                                                                                                                                                   |                                                                                                                                                   |                                                       |                |                 |
| <b>Reference Books:</b>                                                                                                                                                                                                                                                  |                                                                                                                                                   |                                                       |                |                 |
| 1. Environmental Studies - Benny Joseph - Tata McGraw ill- 2005                                                                                                                                                                                                          |                                                                                                                                                   |                                                       |                |                 |
| 2. Principles of Environmental Science and Engineering P. VenugopalaRao, Prentice Hall of India.                                                                                                                                                                         |                                                                                                                                                   |                                                       |                |                 |
| 3. Environmental Science and Engineering - Meenakshi, Prentice Hall India.                                                                                                                                                                                               |                                                                                                                                                   |                                                       |                |                 |
| <b>Assessment Strategy</b>                                                                                                                                                                                                                                               |                                                                                                                                                   |                                                       |                |                 |
| CIE                                                                                                                                                                                                                                                                      | Schedule                                                                                                                                          | Assessment Method                                     | Marks          | Duration (Min.) |
| CIE I                                                                                                                                                                                                                                                                    | At the end of 8 weeks                                                                                                                             | Objective Questions                                   | 25             | 60              |
| CIE II                                                                                                                                                                                                                                                                   | At the end of 11 weeks                                                                                                                            | Objective Questions                                   | 25             | 60              |
| Project                                                                                                                                                                                                                                                                  | At the end of 14 weeks                                                                                                                            | Project/Presentation/Prototype development/Plantation | 50             | -               |

### Course Articulation Matrix

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

## 2024 Admitted Batch

### VI Semester Academic Year 2025-26

| Sl. No.      | Course Category<br>Course Code |           | Course Title                     | Teaching Hours/Week |          |                       |           |                   |
|--------------|--------------------------------|-----------|----------------------------------|---------------------|----------|-----------------------|-----------|-------------------|
|              |                                |           |                                  | Theory Lecture      | Tutorial | Practical/<br>Drawing | Credits   | Duration in hours |
|              |                                |           |                                  | L                   | T        | P                     | C         |                   |
| 1            | IPCC                           | 24ME601   | Heat Transfer                    | 3                   | 0        | 2                     | 4         | 5                 |
| 2            | PCC                            | 24ME602   | Mechanical Vibrations            | 3                   | 0        | 0                     | 3         | 3                 |
| 3            | PEC                            | 24ME63X   | Professional Elective - II       | 3                   | 0        | 0                     | 3         | 3                 |
| 4            | OEC                            | 24OEME64X | Open Elective -I                 | 3                   | 0        | 0                     | 3         | 3                 |
| 5            | PROJ                           | 24ME605   | Major Project Phase - I          | 0                   | 0        | 4                     | 2         | 3                 |
| 6            | PCCL                           | 24ME606   | Design lab                       | 0                   | 0        | 2                     | 1         | 3                 |
| 7            | AEC                            | 24ASK     | Analytical Ability & Soft Skills | 0                   | 0        | 2                     | 1         | 1                 |
| 8            | MC                             | 24ME608   | Sustainable Engineering          | 0                   | 0        | 2                     | 1         | 2                 |
| <b>Total</b> |                                |           |                                  | <b>12</b>           | <b>0</b> | <b>12</b>             | <b>17</b> | <b>23</b>         |

#### Professional Elective-II Course

|         |                                                 |         |                                        |
|---------|-------------------------------------------------|---------|----------------------------------------|
| 24ME631 | Additive Manufacturing                          | 24ME633 | Geometric Dimensioning and Tolerancing |
| 24ME632 | Fundamentals of Industry 4.0 and Industrial IoT | 24ME634 | Automotive Engineering                 |

#### Open Elective-I Course

|          |                                            |
|----------|--------------------------------------------|
| 24OEME61 | Principles of Manufacturing                |
| 24OEME62 | Project Management                         |
| 24OEME63 | Accounting for Engineers                   |
| 24OEME64 | Operations Research                        |
| 24OEME65 | Industrial Engineering and Ergonomics      |
| 24OEME66 | Occupational Health and Safety Engineering |

| Course Title | HEAT TRANSFER |              |                       |
|--------------|---------------|--------------|-----------------------|
| Course Code  | 24ME601       | LTPC         | 3-1-2-4               |
| Exam         | 03 Hours      | Hours / Week | 04                    |
| SEE          | 50            | Total hours  | 42L+14T+28P+36ABL=120 |

**Course Objective:** To equip the students with fundamentals and mechanisms of heat transfer enabling them to develop methodologies for solving practical problems.

**Course Outcomes:** Upon completion of the course, students shall be able to:

| #  | Course Outcomes                                                                                                                                                  | Mapping to POs |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 1. | apply basic law of heat transfer to account for the conscience of modes of heat transfer in thermal analysis of engineering system                               | 1, 2,3,8,9     |
| 2. | analyze unsteady heat transfer in lumped capacitance and semi-infinite solid thermal systems.                                                                    | 1, 2,3         |
| 3. | analyze the heat transfer mechanism through natural and forced convection inside ducts and exterior surfaces                                                     | 1, 2,3,6,8,9   |
| 4. | carry out preliminary design of heat exchanger using LMTD methods and apply the concept of boiling and condensation and the principle of radiation heat transfer | 1, 2,3,6,8,9   |

#### Course contents:

| Module -1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 14Hrs. |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| <b>Introduction:</b> Modes of heat transfer; Basic laws governing modes of heat transfer. Conduction-Basic Equations: Derivation of general form heat conduction equation in rectangular coordinates. Types of boundary conditions, Thermal resistance in series and in parallel. <b>One dimensional steady state conduction:</b> Steady state conduction in a slab, cylinder and sphere with and without heat generation, Composite wall, overall heat transfer coefficient, critical thickness of insulation, Heat transfer in extended surfaces of uniform cross-section without heat generation, long fin, short fin with insulated tip and without insulated tip. Fin efficiency and effectiveness. Numerical problems. |        |
| Module- 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 14Hrs. |
| <b>One-Dimensional Transient Conduction:</b> Conduction in solids with negligible internal temperature gradient (Lumped system analysis), Use of Transient temperature charts (Heisler's charts) for transient conduction in slab, long cylinder, and sphere; Numerical Problems.<br><b>Free or Natural Convection:</b> Application of dimensional analysis for free convection- physical significance of Grashoff number; use of correlations of free convection in vertical, horizontal, and inclined flat plates, vertical and horizontal cylinders and spheres, Numerical problems.                                                                                                                                      |        |
| Module- 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 14Hrs. |
| <b>Forced Convection:</b> Applications of dimensional analysis for forced convection. The physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Use of various correlations for hydro dynamically and thermally developed flows inside a duct, use of correlations for flow over a flat plate, over a cylinder and sphere. Numerical problems. <b>Heat Exchangers:</b> Classification of heat exchangers; overall heat transfer coefficient, fouling and fouling factor; LMTD method of analysis of heat exchangers. Numerical problems.                                                                                                                                                                  |        |
| Module- 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 14Hrs. |
| <b>Condensation And Boiling:</b> Types of condensation (discussion only), use of correlations for condensation on vertical flat surfaces, horizontal tube, and horizontal tube banks; Reynolds number for condensate flow; regimes of pool boiling, pool boiling correlations. Numerical problems. <b>Radiation Heat Transfer:</b> Radiation laws, Thermal radiation; Radiation heat exchange between two parallel infinite black surfaces and infinite gray surfaces; effect of radiation shield; intensity of radiation and solid angle; Numerical problems                                                                                                                                                                |        |

**Text Books**

1. Principals of Heat Transfer, Frank Kreith, Raj M. Manglik, Mark S. Bohn, Seventh Edition, Cengage learning, 2011.
2. Yunus Cengel and Afshin Ghajar, Heat and Mass Transfer: Fundamentals and Applications, McGraw Hill Education (India) Private Limited; 5th Edition, 2015.

**REFERENCE BOOKS:**

1. Fundamentals of Heat and Mass Transfer, Incropera, F. P. and De Witt, D. P., 5th Edition, John Wiley and Sons, New York, 2006.
2. P.K. Nag, Heat & Mass Transfer, TMH, 2008. ISBN:0-07-047337-4
3. S.P. Sukhatme, Heat transfers, 4th edition. ISBN:8173715440
4. R.K. Rajput, Heat & Mass Transfer, S. Chand & Company Ltd, 3rd Edition, 2006. ISBN :81-219-1777-8

**HEAT TRANSFER DATA HANDBOOK:**

1. Heat and Mass Transfer Data Book (S.I. Unit) by CP Kothandaraman and S Subramanyan ISBN:C-21-12-12 894, New age International (P) limited Punblish Edition 2025.

**E-BOOKS/WEB REFERENCES:**

1. A Textbook of Heat Transfer, John H Lienhard, 4th Edition,
2. NPTEL Heat Transfer course for Mechanical Engineering, <http://nptel.ac.in/courses/112101097/>
3. Heat Transfer, Chris Long & Naser Sayma, Bookboon.com

**MOOCs:**

1. Fluid flow, Heat and Mass Transfer- <http://ocw.tudelft.nl/courses/applied-earth-sciences/fluid-flow-heat-mass-transfer/course>
2. Heat transfer course- <https://legacy.saylor.org/me204/Intro/>

| Exp NO. | EXPERIMENT NAME                                                                                        | Marks | COs | Pos         | Level |
|---------|--------------------------------------------------------------------------------------------------------|-------|-----|-------------|-------|
| 1       | Determination of Thermal conductivity of a Metal rod.                                                  | 20    | CO1 | 1,2, 9,10   | 3     |
| 2       | Determination of Thermal conductivity of a liquid                                                      | 20    | CO1 | 1,2, 9,10   | 3     |
| 3       | Determination of overall heat transfer coefficient of a Composite Wall                                 | 20    | CO1 | 1,2, 9,10   | 3     |
| 4       | Determination of Heat Transfer co-efficient for free convection                                        | 20    | CO3 | 1,2, 9,10   | 3     |
| 5       | Determination of Heat Transfer co-efficient for forced convection                                      | 20    | CO3 | 1,2, 7,9,10 | 3     |
| 6       | Determination of Stefan Boltzmann constant                                                             | 20    | CO4 | 1,2, 9,10   | 3     |
| 7       | Determination of emissivity of a surface.                                                              | 20    | CO4 | 1,2, 9,10   | 3     |
| 8       | Determination of efficiency and Effectiveness of the fin by natural convection using pin fin apparatus | 20    | CO1 | 1,2,7, 9,10 | 3     |
| 9       | Determination of efficiency and Effectiveness of the fin by forced convection using pin fin apparatus  | 20    | CO1 | 1,2, 7,9,10 | 3     |
| 10      | Determination of LMTD and effectiveness in a parallel flow and counter flow Heat exchanger             | 20    | CO4 | 1,2, 7,9,10 | 3     |
|         |                                                                                                        |       |     |             |       |



**Teaching - Learning – Evaluation Scheme:**

| Sl. No                                 | Teaching and Learning Method   | No. of Hours/Week | No. of Weeks | Hours/ Semester |
|----------------------------------------|--------------------------------|-------------------|--------------|-----------------|
| 1                                      | Class Room Teaching            | 3                 | 14           | 42              |
| 2                                      | Integrated Lab Component       | 2                 | 14           | 28              |
| 3                                      | Tutorial component             | 1                 | 14           | 14              |
| 4                                      | Activity Based Learning        | -                 | -            | 28              |
| 5                                      | Evaluation of Learning Process | -                 | -            | 08              |
| <b>Total Learning Hours / Semester</b> |                                |                   |              | <b>120</b>      |

**Assessment Plan (for 20 marks of CIE):**

| Tool           | Remarks                                                                                                                                                                                                                                                                                                                                                                | Marks     |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>CIE</b>     | Three CIEs conducted for 20 marks each and reduced to 10 marks                                                                                                                                                                                                                                                                                                         | <b>30</b> |
| <b>Lab</b>     | <b>Lab Component</b><br>Thermal conductivity of a Metal rod & liquid, Composite Wall, Heat Transfer co-efficient for free convection & forced convection, Stefan Boltzmann constant, emissivity of a surface, efficiency and Effectiveness of the fin by natural convection & forced convection using pin fin apparatus, parallel flow and counter flow Heat exchanger | <b>10</b> |
| <b>Lab CIE</b> | <b>Conduction of Lab CIE</b>                                                                                                                                                                                                                                                                                                                                           | <b>05</b> |
| <b>ABL</b>     | To solve steady and unsteady heat conduction problems for simple geometries                                                                                                                                                                                                                                                                                            | <b>05</b> |
|                | To analyse the natural and forced convection process using experimental and analytical methods and correlate the value for effective real time applications.                                                                                                                                                                                                           |           |
|                | To design the heat exchangers using LMTD and effectiveness-NTU method.                                                                                                                                                                                                                                                                                                 |           |
|                | To demonstrate and determine the heat transfer coefficient in film wise & drop wise condensation apparatus and present the report.                                                                                                                                                                                                                                     |           |
|                | To demonstrate the phase change heat transfer and calculate rate of heat transfer using heat exchange process                                                                                                                                                                                                                                                          |           |
|                | To solve steady and unsteady heat conduction problems for simple geometries                                                                                                                                                                                                                                                                                            |           |
| <b>Total</b>   |                                                                                                                                                                                                                                                                                                                                                                        | <b>50</b> |

**Activity-Based Learning (ABL - 50 Hours)****Activities Mapped to Modules:**

| Module       | Activity Description                                                                                                                                         | Hours          |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| 1            | To solve steady and unsteady heat conduction problems for simple geometries                                                                                  | 06             |
| 2            | To analyse the natural and forced convection process using experimental and analytical methods and correlate the value for effective real time applications. | 06             |
| 3            | To design the heat exchangers using LMTD and effectiveness-NTU method.                                                                                       | 06             |
| 4            | To demonstrate and determine the heat transfer coefficient in film wise & drop wise condensation apparatus and present the report.                           | 04             |
| 5            | To demonstrate the phase change heat transfer and calculate rate of heat transfer using heat exchange process                                                | 06             |
| <b>Total</b> |                                                                                                                                                              | <b>28 hrs.</b> |

## Evaluation of Learning Process

| Type of Evaluation | Hours    |
|--------------------|----------|
| Test (1, 2 and 3)  | 3        |
| Lab CIE            | 2        |
| Semester End Exam  | 3        |
| <b>Total</b>       | <b>8</b> |

## Course Articulation Matrix

| Course Outcomes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      |      |      |
|-----------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| COs             | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1             | 3                      | 3   | 2   |     |     |     |     |     | 3   | 3    |      |      |      |
| CO2             | 3                      | 3   | 2   |     |     |     |     |     |     |      |      |      |      |
| CO3             | 3                      | 3   | 2   |     |     | 2   |     |     | 3   | 3    |      |      |      |
| CO4             | 3                      | 3   | 2   |     |     | 2   |     |     | 3   | 3    |      |      |      |

|              |                              |                     |                         |
|--------------|------------------------------|---------------------|-------------------------|
| Course Title | <b>MECHANICAL VIBRATIONS</b> |                     |                         |
| Course Code  | <b>24ME602</b>               | <b>LTPC</b>         | <b>3-0-0-3</b>          |
| Exam         | <b>03 Hours</b>              | <b>Hours / Week</b> | <b>03</b>               |
| SEE          | <b>50Marks</b>               | <b>Total hours</b>  | <b>22L+14T+28ABL=90</b> |

**Course objectives:** To provide basic knowledge on principles of vibrations to analyses, model and build mechanical systems.

**Course Outcomes (COs)** {with mapping shown against the **Program Outcomes**

**(POs)** Upon completion of the course, students shall be able to:

| Cos | CourseOutcomes                                                               | Mapping toPOs | Mapping toPSOs |
|-----|------------------------------------------------------------------------------|---------------|----------------|
| 1.  | Analyzeun-damped and dampedfreevibrationforsingledegreefreedomssystems       | 1,2,3,8,9     | -              |
| 2.  | analyzeforcedvibrationforsingledegreeoffreedomssystems                       | 2,3,8,9       | -              |
| 3.  | designmechanicalsystemstoachievevibrationisolationand measurementofvibration | 2,3,8,9       | -              |
| 4.  | analyzefree&forcedvibrationfortwoandmultidegreeoffreedomssystems             | 2, 3,8,9      | -              |

#### Course Contents:

| Module–1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 12Hrs.  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| <b>Introduction:</b> Types of Vibrations, Simple Harmonic Motion (S.H.M), and principle of superposition applied to Simple Harmonic Motion, Beats, Undamped Free Vibrations: Single degree offreedom systems, Undamped free vibrations natural frequency of free vibration, stiffness of spring elements, effect of mass of spring, Compound Pendulum.<br><b>Damped Free Vibrations:</b> Single degree freedom systems, different types of damping, concept of critical damping and its importance, study of response of viscous damped systems for cases of under damping, critical and over damping, Logarithmic decrement |         |
| Module–2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 08Hrs.  |
| <b>Forced Vibrations:</b> degree freedom systems, steady state solution with viscous damping due to harmonic force. Solution by Complex algebra, reciprocating and rotating unbalance, vibration isolation-transmissibility ratio, due to harmonic excitation and support motion.                                                                                                                                                                                                                                                                                                                                            |         |
| Module–3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 10 Hrs. |
| <b>VibrationMeasuringInstruments&amp;WhirlingofShafts:</b> Vibrometerandaccelerometer. Whirling of shafts with and without air damping, discussion of speeds above and below critical speeds.<br><b>Systems with Two Degrees of Freedom:</b> Introduction, principal modes and normal modes of vibration, co-ordinate coupling, generalized and principal co-ordinates, free vibration in terms of initial conditions.                                                                                                                                                                                                       |         |
| Module–4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 10 Hrs. |
| <b>Numerical Methods for Multi Degree Freedom Systems:</b> Introduction, Influence coefficients, Maxwell reciprocal theorem, Dunkerley’s equation, Holzer’s method, Stodola method.                                                                                                                                                                                                                                                                                                                                                                                                                                          |         |

**Self-Study Component**

1. Harmonic Analysis - Fourier's Series. Vibration Analysis: <https://youtu.be/Vj1xmze3GIE>.
2. Diagnostics for beginners: <https://youtu.be/4fDqII7ut6Y>
3. Applications of Two Degrees of Freedom Systems like vehicle suspension dynamic vibration absorber, Dynamics of reciprocating Engines
4. Mechanical Vibration- Virtual Labs, <http://mdmv-nitk.vlabs.ac.in/#>.

**TEXTBOOKS:**

1. S.S. Rao, *Mechanical Vibrations*, Pearson Education Inc, 6<sup>th</sup> Edition, 2017. ISBN-9780134361307.

**REFERENCE BOOKS:**

1. Leonanrd Meirovitch, *Elements of Vibrations Analysis*, MH, Special Indian edition, 2007, ISBN-81-7700-047-0.
2. S. Graham Kelly, *Mechanical Vibrations*, Schaum's outline series, TMH, Special Indian Edition, 2007, ISBN-14-09780070616790.

**Teaching -Learning- Evaluation Scheme:**

| Sl.No                                | Teaching and Learning Method          | No. of Hours/ Week | No. of Weeks | Hours/ Semester |
|--------------------------------------|---------------------------------------|--------------------|--------------|-----------------|
| 1                                    | Class Room Teaching                   | 3                  | 14           | 42              |
| 2                                    | Integrated Lab Component              | -                  | -            | -               |
| 3                                    | Student Study Hours – Self Learning   | 1                  | 14           | 14              |
| 4                                    | Tutorial component                    | -                  | -            | -               |
| 5                                    | Activity Based Learning (ABL1 & ABL2) | -                  | -            | 28              |
| 6                                    | Evaluation of Learning Process        | -                  | -            | 06              |
| <b>Total Learning Hours/Semester</b> |                                       |                    |              | <b>90</b>       |

**Proposed Assessment Plan (for 50 marks of CIE):**

| Tool                | Remarks                                                                                                                             | Marks     |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------|-----------|
| CIE                 | Three CIEs conducted for 20 marks each and reduced to 10 Marks                                                                      | 30        |
| Details of Activity | Details of activities to be conducted<br>1. Quiz<br>2. Assignments/Problem-solving assignments/Video demonstrations and simulations | 20        |
| <b>Total</b>        |                                                                                                                                     | <b>50</b> |

**Activities Mapped to Modules:**

| Module       | Activity Description                                                                                                 | Hours     |
|--------------|----------------------------------------------------------------------------------------------------------------------|-----------|
| 1            | QUIZ (Based on Self-study component)                                                                                 | 10        |
| 4            | Assignment (Simulation of problems in virtual lab/ Numerical methods for two degree and multi degree freedom system) | 18        |
| <b>Total</b> |                                                                                                                      | <b>28</b> |

**COURSE ATRICULATION MATRIX**

| Course Outcomes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      |      |      |
|-----------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| COs             | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1             | 3                      | 3   | 1   |     |     |     |     | 1   | 1   |      |      |      |      |
| CO2             |                        | 3   | 1   |     |     |     |     | 1   | 1   |      |      |      |      |
| CO3             |                        | 3   | 1   |     |     |     |     | 1   | 1   |      |      |      |      |
| CO4             |                        | 2   | 1   |     |     |     |     | 1   | 1   |      |      |      |      |

|                     |                               |                     |                           |
|---------------------|-------------------------------|---------------------|---------------------------|
| <b>Course Title</b> | <b>ADDITIVE MANUFACTURING</b> |                     |                           |
| <b>Course Code</b>  | <b>22ME631</b>                | <b>LTPC</b>         | <b>3-0-0-3</b>            |
| <b>Exam</b>         | <b>03Hours</b>                | <b>Hours / Week</b> | <b>03</b>                 |
| <b>SEE</b>          | <b>50 Marks</b>               | <b>Total hours</b>  | <b>42 L + 48 ABL = 90</b> |

**Course objectives:** To equip students of other engineering disciplines with the fundamental aspects of Additive Manufacturing processes and their applications

**Course Outcomes (COs)** {with mapping shown against the **Program Outcomes (POs)**}

Upon successful completion of this course, the student shall be able to:

| # | Course Outcomes                                                                                                                                                                  | Mapping to POs | Mapping to PSOs |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------|
| 1 | Explain the fundamentals, historical development, classification, and process chain of rapid prototyping.                                                                        | 1,8,9          | -               |
| 2 | Analyze the principles, parameters, data preparation, and applications of SLA, SLS, FDM, and SGC systems.                                                                        | 1,2, 8,9       | -               |
| 3 | Evaluate advanced techniques like LOM, LENS, and Friction Stir Additive Manufacturing, including their limitations and applications.                                             | 1,2, 8,9       | -               |
| 4 | Apply post-processing techniques to improve AM part properties and select appropriate RP methods for aerospace, biomedical, automotive, jewelry, coin, and tableware industries. | 1,2, 8,9       | -               |

#### Course Contents:

|                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Module – 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>11 Hrs.</b> |
| <b>Introduction:</b> Prototype Fundamentals, Historical Development, Fundamentals of Rapid Prototyping, Advantages of Rapid Prototyping, Commonly Used Terms, Classifications of Rapid Prototyping System.<br><b>Rapid Prototyping Process Chain:</b> Fundamental Automated Processes, Process Chain.<br><b>Stereo Lithography Systems:</b> Principle, Process parameter, Process details, Data preparation, data files and machine details, Application. |                |
| <b>Module – 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>10 Hrs.</b> |
| <b>Selective Laser Sintering:</b> Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications, Process parameter, Path generation, Applications.<br><b>Fusion deposition modeling:</b> Principle, Process parameter, Process details, Applications.<br><b>Solid Ground Curing:</b> Principle of operation, Machine details, Applications.                                                                         |                |
| <b>Module – 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>11 Hrs.</b> |
| <b>Laminated Object Manufacturing:</b> Principle of operation, Process details, application, LOM materials.<br><b>Laser Engineered Net Shaping (LENS):</b> Principle of operation, Process details, applications.<br><b>Friction stirs additive manufacturing:</b> Process, parameters, advantages, limitations and applications.                                                                                                                         |                |
| <b>Module – 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                         | <b>10 Hrs.</b> |
| <b>Post Processing of AM Parts:</b> Support Material Removal, Surface Texture Improvement, Accuracy Improvement, Aesthetic Improvement, Preparation for use as a Pattern, Property Enhancements using Non-thermal and Thermal Techniques.<br><b>Case Studies on Rapid Prototyping Applications:</b> Aerospace Industry, Automotive Industry, Biomedical Industry, Jewelry Industry, Coin Industry and Tableware Industry.                                 |                |

**SELF LEARNING COMPONENT:**

1. 3 D Printers, Historical Development.
2. List the materials used in development of engineering and commercial products using stereo lithography, selective sintering, fused deposition modeling and laminated object manufacturing processes.
3. Rapid Prototyping Applications: Application - Material Relationship, Finishing Processes, Applications in Design, Applications in Engineering, Analysis and Planning, Applications in Manufacturing and Tooling.
  1. Realization of product by modeling simple machine parts or assembly using the 3D printing facilities in the Department.

**TEXT BOOK:**

1. 3D Printing and Additive Manufacturing: Principles & Applications, Chua Chee Kai, Leong Kah Fai, World Scientific, 2015, 4th Edition.
2. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, D.T. Pham, S.S. Dimov, Springer 2001.
3. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson, David W Rosen, Brent Stucker, Springer, 2015, 2nd Edition.

**REFERENCE:**

1. Rapid Prototyping: Principles and Applications in Manufacturing, Rafiq Noorani, John Wiley & Sons, 2006.
2. Additive Manufacturing, Second Edition, Amit Bandyopadhyay Susmita Bose, CRC Press Taylor & Francis Group, 2020..

**Teaching -Learning– Evaluation Scheme:**

| Sl. No                                 | Teaching and Learning Method          | No. of Hours/ Week | No. of Weeks | Hours/ Semester |
|----------------------------------------|---------------------------------------|--------------------|--------------|-----------------|
| 1                                      | Classroom Teaching                    | 3                  | 14           | 42              |
| 2                                      | Integrated Lab Component              | -                  | -            | -               |
| 3                                      | Student Study Hours – Self Learning   | -                  | -            | -               |
| 4                                      | Tutorial component                    | -                  | -            | -               |
| 5                                      | Activity Based Learning (ABL1 & ABL2) | -                  | -            | 40              |
| 6                                      | Evaluation of Learning Process        | -                  | -            | 08              |
| <b>Total Learning Hours / Semester</b> |                                       |                    |              | <b>90</b>       |

**Proposed Assessment Plan (for 50marks of CIE):**

| Tool             | Remarks                                                                                                                                                                                                                                                                                                                   | Marks |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| CIE              | Three CIEs conducted for 20marks each and reduced to 10 marks                                                                                                                                                                                                                                                             | 30    |
| Activity Details | Details of activities to be conducted<br><b>Activity 1:</b> Group of 3 to 4 students should give presentation on Recent Advances in Rapid Prototyping – 4D Printing, Bioprinting, and Large-Scale Additive Manufacturing. <b>10 Marks.</b><br><b>Activity 2:</b> Industrial visitor technical talk by an expert, or NPTEL | 20    |

|              |                                                                  |           |
|--------------|------------------------------------------------------------------|-----------|
|              | <b>videos relevant to Additive Manufacturing (AM). 10 Marks.</b> |           |
| <b>Total</b> |                                                                  | <b>50</b> |

#### Activities Mapped to Modules:

| Module       | Activity Description                                                                                                                                                                                                                                           | Hours     |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| 1            | Students will search for two recent research papers on Recent Advances in Rapid Prototyping , prepare a one-page summary highlighting the principle, process difference from conventional RP, and a potential application in biomedical or aerospace industry. | 20        |
| 2,3 & 4      | Set of MCQs will be used regardless of which activity the student chose. Questions are based on <b>Self-study components</b> .                                                                                                                                 | 20        |
| <b>Total</b> |                                                                                                                                                                                                                                                                | <b>40</b> |

#### Evaluation of Learning Process (8 Hours)

| Type of Evaluation | Hours     |
|--------------------|-----------|
| Test (1, 2 and 3)  | 03        |
| Activity 1         | 01        |
| Activity 2         | 01        |
| Semester End Exam  | 03        |
| <b>Total</b>       | <b>08</b> |

| Course Outcomes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      |      |      |      |
|-----------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| COs             | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1             | 3                      |     |     |     |     |     |     | 1   | 1   |      |      |      |      |      |
| CO2             | 3                      | 2   |     |     |     |     |     | 1   | 1   |      |      |      |      |      |
| CO3             | 3                      | 2   |     |     |     |     |     | 1   | 1   |      |      |      |      |      |
| CO4             | 3                      | 2   |     |     |     |     |     | 1   | 1   |      |      |      |      |      |



|                     |                                                        |                     |                     |
|---------------------|--------------------------------------------------------|---------------------|---------------------|
| <b>Course Title</b> | <b>Fundamentals of Industry 4.0 and Industrial IoT</b> |                     |                     |
| <b>Course Code</b>  | <b>23ME632</b>                                         | <b>LTPC</b>         | <b>3-0-0-3</b>      |
| <b>Exam</b>         | <b>03 Hours</b>                                        | <b>Hours / Week</b> | <b>03</b>           |
| <b>SEE</b>          | <b>100 Marks</b>                                       | <b>Total hours</b>  | <b>42L+48ABL=90</b> |

### Course Objective:

The course is designed to offer fundamentals of Industry 4.0, IoT and their applications in the business world. Learners will gain deep insights into how smartness is being harnessed from data and appreciate what needs to be done in order to overcome some of the challenges, especially in the field of Mechanical Engineering.

### Course Outcomes (COs)

Upon completion of the course, students shall be able to:

| # | Course Outcomes                                                                                                             | Mapping to POs | Mapping to PSOs |
|---|-----------------------------------------------------------------------------------------------------------------------------|----------------|-----------------|
| 1 | Knowing fundamentals of Industry 4.0, Industrial revolution and challenges being faced                                      | 1,6            | -               |
| 2 | Information on sensors and actuators used in Industry 4.0, Smart Manufacturing and other cyber-physical related attributes. | 1,5            | -               |
| 3 | Studying various aspects of IoT, IIoT, current technologies that are driving industries in manufacturing and management.    | 1,5,6,11       | -               |
| 4 | Applications and Case Studies of IoT and IIoT in various streams                                                            | 1,4,11         | -               |

### Course contents:

| <b>Module -1</b>                                                                                                                                                                                                                                                                                                                                                             | <b>10 Hrs.</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Industry 4.0</b><br>Introduction, Various Industrial Revolutions, Fourth Revolution, Drivers, Enablers and Challenges for Industry 4.0.<br>Lean Production System, Smart Factories, Smart and Connected Business Perspectives, Collaboration Platform and Product Life-Cycle Management.                                                                                  |                |
| <b>Module- 2</b>                                                                                                                                                                                                                                                                                                                                                             | <b>10 Hrs.</b> |
| Cyber-Physical Systems (CPS) and Next Generation Sensors, Industrial Sensing and Actuation, Smart Manufacturing, Smart Devices and Products, Smart Logistics.<br>Automation and Robotics in Industry, Artificial Intelligence, Support system for Industry 4.0, Opportunities in future and strategies for competing in Industry 4.0 era.                                    |                |
| <b>Module- 3</b>                                                                                                                                                                                                                                                                                                                                                             | <b>10 Hrs.</b> |
| <b>Industrial IoT</b><br>Introduction, Internet of Things (IoT), Industrial IoT, Industrial Processes, Advanced technologies: Software Defined Networking and Security in IIoT.<br>Key Enablers of IIoT: Sensing, Connectivity, Processing & Process control, IIoT Analytics and Data Management: Machine Learning and Cloud computing (Brief description only)              |                |
| <b>Module- 4</b>                                                                                                                                                                                                                                                                                                                                                             | <b>10 Hrs.</b> |
| Applications of IIoT: Inventory Management & Quality Control, Plant Security and Safety, Facility Management, Oil-Chemical & Pharmaceutical Industry, UAVs in Industries, Factories and Assembly Line, Food Industry<br>Case Studies for Industry 4.0 and IIoT: Milk Processing & Packaging Industries, Manufacturing Industries, Virtual Reality Lab, Steel Technology Lab. |                |

**Self Study Component:**

1. Advanced robotic applications in various industries.
2. Programming of Raspberry Pi and other similar microcontrollers

**Activity:**

1. Developing simple working models using IoT platform.

**Text Book**

1. Oliver Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things – Key Applications and Protocols”, Wiley Publications, 2011. ISBN: 1119966701.

**Reference Books:**

1. Alasdair Gilchrist, “Industry 4.0: The Industrial Internet of Things”, Apress, 1<sup>st</sup> Edition, 2017. ISBN: 1484220463.
2. RMD SundaramShriram K Vasudevan, Abhishek S Nagarajan, “Internet of Things”, Wiley Publications, 2019. ISBN: 8126578378.

**Teaching -Learning– Evaluation Scheme:**

| Sl.No                                | Teaching and Learning Method        | No. of Hours/ Week | No. of Weeks | Hours/ Semester |
|--------------------------------------|-------------------------------------|--------------------|--------------|-----------------|
| 1                                    | Class Room Teaching & Learning      | 03                 | 14           | 42              |
| 2                                    | Integrated Lab Component            |                    |              |                 |
| 3                                    | Student Study Hours – Self Learning | 01                 | 14           | 14              |
| 4                                    | Tutorial Component                  |                    |              |                 |
| 5                                    | Activity Based Learning (ABL 1&2)   | 02                 | 14           | 28              |
| 6                                    | Evaluation of Learning Process      | -                  | -            | 06              |
| <b>Total Learning Hours/Semester</b> |                                     |                    |              | <b>90</b>       |

**Proposed Assessment Plan (for 50marks of CIE):**

| Tool                   | Remarks                                                                                                                          | Marks     |
|------------------------|----------------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>CIE</b>             | Three CIEs conducted for 20 marks each and reduced to 10marks                                                                    | 30        |
| <b>ABL (1 &amp; 2)</b> | Presentation on the selected topics from the syllabus (ABL1) and Demonstration of a Working Model related to the syllabus (ABL2) | 20        |
| <b>Total</b>           |                                                                                                                                  | <b>50</b> |

**Activities Mapped to Modules:**

| Module       | Activity Description                                                         | Hours     |
|--------------|------------------------------------------------------------------------------|-----------|
| 1            | Preparation of material for presentation using PPT/ Charts/ Model/ Prototype | 07        |
| 2            | Preparation of material for presentation using PPT/ Charts/ Model/ Prototype | 07        |
| 3            | Preparation of material for presentation using PPT/ Charts/ Model/ Prototype | 07        |
| 4            | Preparation of material for presentation using PPT/ Charts/ Model/ Prototype | 07        |
| <b>Total</b> |                                                                              | <b>28</b> |

**Evaluation of Learning Process (7Hours)**

| Type of Evaluation | Hours     |
|--------------------|-----------|
| CIE (1, 2 & 3)     | 03        |
| ABL 1              | 02        |
| ABL 2              | 01        |
| <b>Total</b>       | <b>06</b> |

**Course Articulation Matrix**

| Course Outcomes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      |      |      |
|-----------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| COs             | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| 5.              | 3                      |     |     |     |     | 2   |     |     |     |      |      |      |      |
| 6.              | 3                      |     |     |     | 2   |     |     |     |     |      |      |      |      |
| 7.              | 3                      |     |     |     | 2   | 2   |     |     |     |      | 1    |      |      |
| 8.              | 3                      |     |     | 2   |     |     |     |     |     |      | 2    |      |      |

|                     |                                               |                     |                     |
|---------------------|-----------------------------------------------|---------------------|---------------------|
| <b>Course Title</b> | <b>GEOMETRIC DIMENSIONING AND TOLERANCING</b> |                     |                     |
| <b>Course Code</b>  | <b>24ME633</b>                                | <b>LTPC</b>         | <b>3-0-0-3</b>      |
| <b>Exam</b>         | <b>3 Hours</b>                                | <b>Hours / Week</b> | <b>3</b>            |
| <b>SEE</b>          | <b>50 Marks</b>                               | <b>Total hours</b>  | <b>42L+48ABL=90</b> |

**Course Objective:** To teach the students concepts and interpretation of Geometric Dimensioning and Tolerancing of a component that goes into assembly from the point of view of Design, manufacture and assembly

### Course Outcomes (COs)

Upon completion of the course, students shall be able to:

| #  | Course Outcomes                                                                                                                                                                  | Mapping to POs | Mapping to PSOs |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------|
| 1. | Comprehend the interdependence of design and manufacturing processes to produce cost-effective and quality products, and recognize tolerance symbols used in component drawings. | 1, 8, 9        | -               |
| 2. | Interpret the functional significance of component features and specify appropriate tolerances and fits between mating parts in an assembly.                                     | 1, 3, 4, 9     | -               |
| 3. | Identify and apply suitable inspection methods and techniques for effective and economical quality control.                                                                      | 1, 4, 9, 11    | -               |

### Course contents:

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Module -1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>10 Hrs.</b> |
| <b>Introduction to Geometrical Tolerancing:</b> Need for GD&T, Size general principles, Definitions of size, Groups of sizes and dimensions. Classification and symbols of Geometric Tolerancing. <b>Tolerances of form</b> - General concepts, Straightness, Roundness, Flatness, Cylindricity, Line and surface profile, Rules for form Tolerancing.                                                                                                                                                                                                                 |                |
| <b>Module- 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>10 Hrs.</b> |
| <b>Datums:</b> Datums, datum features and simulated datum features, establishing datums, Datum targets, Datum systems - Three-Plane datum-system, Groups of features nominated as datums. <b>Tolerances of Orientation:</b> Parallelism Perpendicularity and Angularity tolerances with typical examples.                                                                                                                                                                                                                                                              |                |
| <b>Module- 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>10 Hrs.</b> |
| <b>Tolerance of location:</b> Position, Concentricity & Coaxiality and Symmetry tolerances of line or surface with or without datum - Profile any line, Profile any surface. <b>Tolerances of runout:</b> Circular run-out, Circular run-out in the radial direction, Circular run-out in the axial and in any direction, total runout. <b>Material Conditions:</b> Maximum and least material condition, Shift Tolerance, Principle of independency, Maximum material condition, Maximum material virtual limit, least material requirement, Reciprocity requirement. |                |
| <b>Module- 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>10 Hrs.</b> |

Taylor's Principle of design of gauges, Taylor's Envelop Principle, Go and No-Go gauges for size, Terms and Definitions for Individual Features of Size, Actual Size Definitions, Relationship of individual Features, Perfect Orientation between Features. Projected tolerance zone, Free state Tolerancing. Introduction to stack up analysis.

**Text Book:**

1. Geometrical Product Specifications – Course for Technical Universities by Z. Humienny et al, Warsaw University Press 2001

**Reference Books:**

1. Geometric Dimensioning and Tolerancing, for Mechanical design by Gene R. Cogorno, McGraw Hill, 2006
2. Geometric Dimensioning and Tolerancing – James D. Meadows, Marcel Dekker Inc., Special Indian Edition, 1995

**Teaching -Learning– Evaluation Scheme:**

| Sl.No                                | Teaching and Learning Method        | No. of Hours/ Week | No. of Weeks | Hours/ Semester |
|--------------------------------------|-------------------------------------|--------------------|--------------|-----------------|
| 1                                    | Class Room Teaching                 | 3                  | 14           | 42              |
| 2                                    | Integrated Lab Component            | -                  | -            | -               |
| 3                                    | Student Study Hours – Self Learning | 1                  | 14           | 14              |
| 4                                    | Tutorial component                  | -                  | -            | -               |
| 5                                    | Activity Based Learning             | 2                  | 13           | 26              |
| 6                                    | Evaluation of Learning Process      | -                  | -            | 08              |
| <b>Total Learning Hours/Semester</b> |                                     |                    |              | <b>90</b>       |

**Proposed Assessment Plan (for 50marks of CIE):**

| Tool             | Remarks                                                                                                                                                                                                                                                                                                                                                                                                           | Marks     |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| CIE              | Three CIEs conducted for 20marks each and reduced to 10 marks                                                                                                                                                                                                                                                                                                                                                     | <b>30</b> |
| Activity Details | Details of activities to be conducted<br>4) Group activity to undergo survey on various applications of GD&T symbols in production drawings of real-world/Practical applications with demonstration of suitable inspection method and prepare a report/Drawing on it.(10M)<br>5) Group activity on preparation of GD&T models for different types of tolerances and prepare a report on it.(10M)(From self-study) | <b>20</b> |

**Activities Mapped to Modules:**

| Module  | Activity Description                                                                                                                                                                                                     | Hours |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1,2,3,4 | Group activity to undergo survey on various applications of GD&T symbols in production drawings of real-world/Practical applications with demonstration of suitable inspection method and prepare a report/Drawing on it | 13    |
| 1,2,3   | Group activity on preparation of GD&T models for different types of tolerances and prepare a report on it. (From self-study)                                                                                             | 13    |

|         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |           |
|---------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| 1,2,3,4 | <b>Student Study Hours – Self Learning</b> <ul style="list-style-type: none"> <li>➤ ASME standard: ASME Y14.5 overview.</li> <li>➤ Applications of Form Tolerances in Manufacturing &amp; inspection methods of form tolerancing (V- Block, dial gauge, CMM).</li> <li>➤ Orientation Tolerances in Assembly Fit-mounting faces in gearboxes, brackets, impact on assembly alignment and performance.</li> <li>➤ Location tolerances criticality in production-A Case study: bolt hole patterns in flanges.</li> <li>➤ Profile Tolerances in Complex Surfaces- Applications in aerospace/automotive body panels. applications in castings and plastic molded parts.</li> <li>➤ Runout Tolerances in Rotating Components-Circular runout vs total runout, Examples: shafts, spindles, turbine components, Effect on vibration and wear.</li> <li>➤ GD&amp;T in CNC and Automated Manufacturing- How GD&amp;T is interpreted in CAM programs, Role in CNC machining accuracy, Link between CAD models and tolerancing.</li> <li>➤ Inspection &amp; Metrology Techniques-Coordinate Measuring Machines (CMM), Optical measurement systems, Functional gauges vs digital inspection.</li> <li>➤ Emerging Trends-Model-Based Definition (MBD), Digital twins and GD&amp;T integration, Use of GD&amp;T in Industry 4.0.</li> </ul> | 14        |
|         | <b>Total</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>40</b> |

#### Evaluation of Learning Process (8 Hours)

| Type of Evaluation    | Hours     |
|-----------------------|-----------|
| CIE/Test (1, 2 and 3) | 03        |
| Presentation          | 02        |
| Semester End Exam     | 03        |
| <b>Total</b>          | <b>08</b> |

#### Course Articulation Matrix

| Course Outcomes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      |      |      |      |
|-----------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
|                 | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| COs             | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1             | 3                      | -   | -   | -   | -   | -   | -   | 2   | 2   | -    | -    | -    | -    | -    |
| CO2             | 2                      | -   | 3   | 2   | -   | -   | -   | -   | 3   | -    | -    | -    | -    | -    |
| CO3             | 2                      | -   | -   | 3   | -   | -   | -   | -   | 3   | -    | 2    | -    | -    | -    |

|                     |                               |                     |                     |
|---------------------|-------------------------------|---------------------|---------------------|
| <b>Course Title</b> | <b>AUTOMOTIVE ENGINEERING</b> |                     |                     |
| <b>Course Code</b>  | <b>23ME634</b>                | <b>LTPC</b>         | <b>3-0-0-3</b>      |
| <b>Exam</b>         | <b>03 Hours</b>               | <b>Hours / Week</b> | <b>03</b>           |
| <b>SEE</b>          | <b>50 Marks</b>               | <b>Total hours</b>  | <b>42L+48ABL=90</b> |

### Course objectives:

To impart knowledge on components of automotive systems and their functions

**Course Outcomes (COs)** {with mapping shown against the **Program Outcomes (POs)}** Upon completion of the course, students shall be able to:

| COs | Statement                                                                                                 | POs    | PSOs |
|-----|-----------------------------------------------------------------------------------------------------------|--------|------|
| 1.  | Describe the functional components and mechanisms of IC engines                                           | 1, 2   | -    |
| 2.  | Summarize the cooling, lubrication, ignition, and fuel supply systems of IC engines.                      | 1, 2,7 | -    |
| 3.  | Explain the importance and functions of the transmission, suspension, and braking systems of automobiles. | 1,2    | -    |
| 4.  | Choose the fuel, mixture requirements, and methods of emission control for IC engines.                    | 1, 2,7 |      |

### COURSE CONTENTS:

| Module – I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 10 Hrs. |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| <b>Introduction:</b> Components of an automobile, engine systems, types of engines, cylinder-arrangements, Engine Components- liners, piston, piston rings, connecting rod, camshaft, crankshaft, valves, valve actuating mechanisms and choice of materials for different engine components.<br><b>Cooling &amp; Lubrication Systems:</b> Cooling requirements, methods of cooling- air and water cooling, Objects and methods of lubrication systems.                                                                                                                                                                                           |         |
| Module – II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 10 Hrs. |
| <b>Ignition Systems:</b> Requirements of an ignition system, Types - Battery and magneto ignition systems, transistor assist contacts electronic ignition, automatic ignition advance systems.<br><b>Fuels &amp; Fuel Supply Systems for SI &amp; CI Engines:</b> Normal and abnormal combustion. Mixture strength requirements of SI engines, simple carburetor, single point and multi point petrol injection systems, diesel injection system- common rail and individual pump injection methods.<br><b>Superchargers and Turbochargers:</b> Supercharger- types, construction detail and working principle, Turbo charger & turbocharger lag. |         |
| Module – III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 10 Hrs. |
| <b>Clutches:</b> Requirements and principle of operation. Types- single plate, multi-plate and centrifugal clutches. <b>Transmission system:</b> Necessary of transmission, types – constant mesh boxes, automatic transmissions, epicyclic gear trains.<br><b>Drive To Wheels:</b> Propeller shaft and universal joints, final drive, differential, rear axle, rear axle drives- Hotchkiss and torque tube drives.<br><b>Steering system:</b> Introduction, steering linkage for rigid axle and, steering gears & power steering.                                                                                                                |         |
| Module – IV                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 10 Hrs. |
| <b>Suspension system:</b> Requirements, Torsion bar suspension systems, leaf spring, coil spring, shock absorbers and air suspension system.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |         |

**Brakes:** Requirements, method of actuation, drum brakes, disk brakes, antilock braking systems (ABS).

**Emission Control Systems:** Introduction, methods of emission controls - controlling crankcase ventilation, controlling evaporative emissions, redesigning the engine, treating the exhaust gas for SI and CI engine emission standards.

#### **SELF LEARNING COMPONENTS:**

- Automotive electrical System: Charging system, starting system, storage batteries, lighting system, safety sensors etc.
- Accessories: Air-conditioning, power windows, central locking, vehicle tracking system, cruise control, keyless entry etc.
- Classification and specification of Motorcycles, four, Six, and more than Six-wheel vehicles.

-

#### **TEXTBOOKS :**

1. Dr. Kirpal Singh, Automobile Engineering, Vol. 1 Standard publisher's distributors, 13<sup>th</sup> Edition 2013. ISBN: 978-81-8014-196-6.

2. Dr. Kirpal Singh, Automobile Engineering, Vol. 2 Standard publisher's distributors, 13<sup>th</sup> Edition 2014. ISBN: 978-81-8014-206-2.

#### **REFERENCE BOOKS**

1 R. B. Gupta, Automobile Engineering, Satya Prakashan, 4<sup>th</sup> Edition. 1984. ISBN: 9788176843799.

2. V. Ganesan, Internal combustion engines, McGraw-Hill Education, 4<sup>th</sup> Edition 2013. ISBN: 978-1-25-900619-7.

3. N. K. Giri, Automobile Mechanics, Khanna Publisher, 8<sup>th</sup> Edition 2008. ISBN: 978-8174092168

Teaching - Learning - Evaluation Scheme:

| Sl. No                        | Teaching and Learning Method   | No. of Hours/ Week | No. of Weeks | Hours/ Semester |
|-------------------------------|--------------------------------|--------------------|--------------|-----------------|
| 1                             | Class Room Teaching & Learning | 03                 | 14           | 42              |
| 2                             | Integrated Lab Component       | -                  | -            | -               |
| 3                             | Evaluation of Learning Process | -                  | -            | 08              |
| 4                             | Activity Based Learning (ABL)  | -                  | -            | 40              |
| Total Learning Hours/Semester |                                |                    |              | 90              |

#### **Proposed Assessment Plan (for 50 marks of CIE):**

| Tool             | Remarks                                                         | Marks     |
|------------------|-----------------------------------------------------------------|-----------|
| Internals        | Three tests conducted for 20 marks each and reduced to 10 marks | 30        |
| Activity Details | 1) Industrial Visit                                             | 10        |
|                  | 2) Assignment and Quiz                                          | 10        |
| <b>Total</b>     |                                                                 | <b>50</b> |



### Activity Based Learning (40Hours)

| ABL (40Hours): Students visit the Automobile industrial/work shop to enhance their knowledge and skill |                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Hours |
|--------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Students present their industrial/workshop report and give presentation                                | <ul style="list-style-type: none"> <li>• Introduction to Automobile Industry and Safety Practices</li> <li>• Study of Automobile Components and Systems</li> <li>• Engine Construction and Working (SI &amp; CI Engines)</li> <li>• Fuel Supply and Ignition Systems</li> <li>• Transmission System (Clutch, Gearbox, Differential)</li> <li>• Automobile Electrical and Electronic Systems</li> <li>• Vehicle Maintenance and Servicing Procedures</li> </ul> | 40    |
| Total                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 40    |

### Evaluation of Learning Process (08Hours)

| Type of Evaluation                          | Hours |
|---------------------------------------------|-------|
| Test (1,2 and 3)                            | 03    |
| Industrial Visit/Assignment/quiz evaluation | 02    |
| Semester End Exam                           | 03    |
| Total                                       | 08    |

### Course Articulation Matrix

| Course Outcomes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      |      |      |      |
|-----------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
|                 | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1             | 2                      | 3   | 1   |     |     |     |     | 1   | 1   |      |      |      |      |      |
| CO2             | 2                      | 3   | 1   |     |     | 1   |     | 1   | 1   |      |      |      |      |      |
| CO3             | 2                      | 3   | 1   |     |     |     |     | 1   | 1   |      |      |      |      |      |
| CO4             | 2                      | 3   | 1   |     |     | 1   |     | 1   | 1   |      |      |      |      |      |

|                     |                                    |                     |                     |
|---------------------|------------------------------------|---------------------|---------------------|
| <b>Course Title</b> | <b>PRINCIPLES OF MANUFACTURING</b> |                     |                     |
| <b>Course Code</b>  | <b>24OEME61</b>                    | <b>LTPC</b>         | <b>3-0-0-3</b>      |
| <b>Exam</b>         | <b>03Hours</b>                     | <b>Hours / Week</b> | <b>03</b>           |
| <b>SEE</b>          | <b>50 Marks</b>                    | <b>Total hours</b>  | <b>42L+48ABL=90</b> |

**Course objectives:** To equip students of other engineering disciplines with the fundamental aspects of manufacturing processes and their applications

**Course Outcomes (COs)** {with mapping shown against the **Program Outcomes (POs)**}

Upon successful completion of this course, the student shall be able to:

| # | Course Outcomes                                                                                                                               | Mapping to POs | Mapping to PSOs |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------|
| 1 | understand the fundamentals and working principles of manufacturing processes including metal forming and non-traditional machining processes | 1,5,8,9        | -               |
| 2 | describe the significance and applications of various joining techniques and surface processing methods used in manufacturing.                | 1,2            | -               |
| 3 | realizethe fundamentals and applications of modern manufacturing technologies such as rapid prototyping and integrated circuit processing.    | 1,5,8,9        | -               |

#### Course Contents:

|                                                                                                                                                                                                                                                                                                        |                |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Module – 1</b>                                                                                                                                                                                                                                                                                      | <b>11 Hrs.</b> |
| <b>Introduction and overview of manufacturing:</b> Definition,materials in manufacturing, classification of manufacturing processes.                                                                                                                                                                   |                |
| <b>Fundamentals of metal forming:</b> Overview of metal forming, working principle, advantages, limitations and applications of rolling, forging, extrusion, wire and bar drawing, sheet metal operations – shearing, blanking and punching, bending operations – V and Edge bending.                  |                |
| <b>Module – 2</b>                                                                                                                                                                                                                                                                                      | <b>10 Hrs.</b> |
| <b>Fundamentals of material removal:</b> Traditional vs. Non-traditional machining process, working principle, advantages, limitations and applications of ultrasonic machining, abrasive jet machining, electrochemical machining, chemical machining, laser beam machining, electron beam machining. |                |
| <b>Module – 3</b>                                                                                                                                                                                                                                                                                      | <b>11 Hrs.</b> |
| <b>Fundamentals of joining processes:</b> Definition,types of welding process,working principle, advantages, limitations and applications of electron beam welding, laser beam welding and ultrasonic welding.                                                                                         |                |
| <b>SurfaceProcessingOperations:</b> Plating and Related Processes – electroplating, electroless plating; Chemical Conversion Coatings - phosphate coating, chromate coating, anodizing; Organic Coatings; Porcelain Enameling.                                                                         |                |
| <b>Module – 4</b>                                                                                                                                                                                                                                                                                      | <b>10 Hrs.</b> |
| <b>Rapid Prototyping:</b> Fundamentals of rapid prototyping; liquidbased systems – stereolithography; powderbased systems - selective laser sintering; molten material systems - fused-deposition modeling; additive manufacturing applications.                                                       |                |
| <b>Processing of integrated circuits:</b> Definition, overview of IC processing - processing sequence and clean rooms, IC packaging.                                                                                                                                                                   |                |

**TEXTBOOK:**

4. Mikell, P. Groover. Fundamentals of modern manufacturing: materials, processes and systems. JOHN WILEY, 2019.

**REFERENCE BOOKS:**

3. Black, J. Temple, and Ronald A. Kohser. DeGarmo's materials and processes in manufacturing. John Wiley & Sons, 2017.
4. Pham, Duc, and Stefan S. Dimov. Rapid manufacturing: the technologies and applications of rapid prototyping and rapid tooling. Springer Science & Business Media, 2012.
5. Production Technology, HMT TATA McGraw Hill 2001 ISBN-0070764432.
6. Adityan, Modern Machining Process, 2002. ISBN-85143774 -11.

**Teaching -Learning– Evaluation Scheme:**

| Sl. No                                 | Teaching and Learning Method          | No. of Hours/ Week | No. of Weeks | Hours/ Semester |
|----------------------------------------|---------------------------------------|--------------------|--------------|-----------------|
| 1                                      | Classroom Teaching                    | 3                  | 14           | 42              |
| 2                                      | Integrated Lab Component              | -                  | -            | -               |
| 3                                      | Student Study Hours – Self Learning   | -                  | -            | -               |
| 4                                      | Tutorial component                    | -                  | -            | -               |
| 5                                      | Activity Based Learning (ABL1 & ABL2) | -                  | -            | 40              |
| 6                                      | Evaluation of Learning Process        | -                  | -            | 08              |
| <b>Total Learning Hours / Semester</b> |                                       |                    |              | <b>90</b>       |

**Assessment Plan (for 50marks of CIE):**

| Tool             | Remarks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Marks     |
|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| CIE              | Three CIEs conducted for 20marks each and reduced to 10 marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 30        |
| Activity Details | <p>Details of activities to be conducted</p> <ol style="list-style-type: none"> <li>1. Activity 1: Conduct any experiment related to the course content using the virtual lab (<a href="https://www.vlab.co.in/broad-area-mechanical-engineering">https://www.vlab.co.in/broad-area-mechanical-engineering</a>; <a href="http://vlabs.iitkgp.ac.in/vlt/">http://vlabs.iitkgp.ac.in/vlt/</a>), prepare a report, and submit the details of the pre-test and post-test marks – <b>10 Marks</b></li> <li>2. Activity 2: Prepare a model using an FDM 3D printer and submit the related files, including the CAD file, STL file, slicing details, printer settings, and the printed model – <b>10 Marks.</b></li> </ol> | 20        |
| <b>Total</b>     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>50</b> |

**Activities Mapped to Modules:**

| Module       | Activity Description                                                                                                        | Hours     |
|--------------|-----------------------------------------------------------------------------------------------------------------------------|-----------|
| 1            | Virtual Lab Simulation of Metal Forming processes, Group presentations on simulation studies, Taking pre and posttest quiz. | 20        |
| 4            | CAD Modelling, STL file preparation and printing a model using FDM based 3D printer.                                        | 20        |
| <b>Total</b> |                                                                                                                             | <b>40</b> |

**Evaluation of Learning Process (8 Hours)**

| Type of Evaluation | Hours     |
|--------------------|-----------|
| Test (1, 2 and 3)  | 03        |
| Activity 1         | 01        |
| Activity 2         | 01        |
| Semester End Exam  | 03        |
| <b>Total</b>       | <b>08</b> |

| Course Outcomes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      |      |      |      |
|-----------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| COs             | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1             | 3                      |     |     |     | 1   |     |     | 2   | 1   |      |      |      |      |      |
| CO2             | 3                      | 2   |     |     |     |     |     |     |     |      |      |      |      |      |
| CO3             | 3                      |     |     |     | 2   |     |     | 2   | 1   |      |      |      |      |      |

|                     |                           |                     |                     |
|---------------------|---------------------------|---------------------|---------------------|
| <b>Course Title</b> | <b>Project Management</b> |                     |                     |
| <b>Course Code</b>  | <b>24OEME62</b>           | <b>LTPC</b>         | <b>1-0-0-3</b>      |
| <b>Exam</b>         | <b>3 Hours</b>            | <b>Hours / Week</b> | <b>03 Hours</b>     |
| <b>SEE</b>          | <b>50Marks</b>            | <b>Total hours</b>  | <b>42L+48ABL=90</b> |

### Course objectives:

To impart comprehensive understanding of how to plan, optimize and efficiently manage projects (or tasks) to implement products, services or developments.

Course Outcomes (COs) {with mapping shown against the Program Outcomes

(POs)) Upon successful completion of this course, the student shall be able to

| # | Course Outcomes                                                                                                                               | Mapping to POs | Mapping to PSOs |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------|
| 1 | explain the fundamental principles of project management, organizational structures, and the roles and responsibilities of a project manager. | 1, 7, 8, 9, 10 | -               |
| 2 | describe the different methods and techniques used in project management.                                                                     | 1, 3, 8, 10    | -               |
| 3 | analyze the role of software effort estimation techniques in project management and conduct case study analysis of projects.                  | 1, 8, 9, 10    | -               |

### Course Contents:

| Module-I                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 11 Hrs. |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| <b>Introduction to Project Management:</b> Concept of project and project management, characteristic features and classification of projects, phases of project management, selection of project managers and their duties.<br><b>Project Planning and Estimation:</b> Project planning steps, objectives and goals of the project, Feasibility reports, financing arrangements, preparation of cost estimation. 7's of project Management.                                                                                                                                            |         |
| Module – II                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 10 Hrs. |
| <b>Organizing and Staffing the Project Team:</b> Authorities of project manager, organizational structure and types, accountability in project execution, contracts, 3 'R's of contracting, tendering process and selection of contractors, team building.<br><b>Project Scheduling Tools and Techniques:</b> Gantt chart, bar chart for combined activities, Critical path method (CPM) and Project evaluation and review technique (PERT), Numerical problems.                                                                                                                       |         |
| Module-III                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 11 Hrs. |
| <b>Project Direction, Coordination and Control:</b> Project direction, communication in a project, PMIS, project coordination and schedule control & cost control.<br>Resource allocation, Resource loading and leveling, Constrained resource scheduling. Risk management: Introduction, Risk Management Process, Monitoring and Control Risks. <b>ISO</b> and concepts of total quality management and six sigma.<br><b>Performance Measures in Project Management:</b> Performance indicators, performance improvement, project management environment and Project Control Process. |         |

| <b>Module–IV</b>                                                                                                                                                                                                                                                       | <b>10 Hrs.</b> |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Software project management:</b> Introduction, computerized project management, managing software projects, overview of capability maturity model (CMM), project management and the CMM. <b>Casestudiesonprojectmanagement:</b> Modern cases in project management. |                |

|                                                                                                                                                                                                                                                                                                                                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>TextBook:</b><br>3. Project Management a System approach to planning Scheduling & Controlling - Harold Kerzner, 10th edition 2009, John Wiley & sons.<br>4. Chaudhry S, Project Execution Plan - Plan for project Execution interaction, 2001                                                                                                                                |
| <b>ReferenceBooks:</b><br>5. Software Project Management in Practice - Pankaj Jalote, Pearson education<br>6. Fundamentals of Project Management: Rory Burke, 2010, Burke Publishing.<br>7. Project planning scheduling & control, James P. Lawis, Meo Publishing Company, 5th edition 2010.<br>8. A Management Guide to PERT and CPM, WEIST & LEVY - Eastern Economy PHI 2002. |

#### Teaching -Learning– Evaluation Scheme:

| <b>Sl. No</b>                          | <b>Teaching and Learning Method</b>   | <b>No. of Hours/ Week</b> | <b>No. of Weeks</b> | <b>Hours/ Semester</b> |
|----------------------------------------|---------------------------------------|---------------------------|---------------------|------------------------|
| 1                                      | Class Room Teaching                   | 3                         | 14                  | 42                     |
| 2                                      | Integrated Lab Component              | -                         | -                   | -                      |
| 3                                      | Student Study Hours – Self Learning   | -                         | -                   | -                      |
| 4                                      | Tutorial component                    | -                         | -                   | -                      |
| 5                                      | Activity Based Learning (ABL1 & ABL2) | -                         | -                   | 40                     |
| 6                                      | Evaluation of Learning Process        | -                         | -                   | 08                     |
| <b>Total Learning Hours / Semester</b> |                                       |                           |                     | <b>90</b>              |

#### Proposed Assessment Plan (for 50marks of CIE):

| <b>Tool</b>      | <b>Remarks</b>                                                                                                                                                                                                                                                                                                                                                                                              | <b>Marks</b> |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| CIE              | Three CIEs conducted for 20 marks each and reduced to 10 marks                                                                                                                                                                                                                                                                                                                                              | 30           |
| Activity Details | Details of activities to be conducted<br>6) Details of activity 1 - Conduct quiz on each module and take the average marks. -- <b>05 Marks.</b><br>7) Details of activity 2 - The surprise test will be conducted from module 2/3. – <b>05 Marks.</b><br>8) Details of activity 3 – Conduct a case study on any project management example, prepare a report, and present their findings. - <b>10 Marks</b> | 20           |
| <b>Total</b>     |                                                                                                                                                                                                                                                                                                                                                                                                             | <b>50</b>    |

**Activities Mapped to Modules:**

| Module       | Activity Description                                                          | Hours     |
|--------------|-------------------------------------------------------------------------------|-----------|
| 1, 2 & 3     | Preparation for the quiz and surprise test.                                   | 08        |
| 4            | A case study on any project example, prepare of the report, and presentation. | 32        |
| <b>Total</b> |                                                                               | <b>40</b> |

**Evaluation of Learning Process (08 Hours)**

| Type of Evaluation | Hours     |
|--------------------|-----------|
| Test (1, 2 and 3)  | 03        |
| Quiz               | 01        |
| Presentation       | 01        |
| Semester End Exam  | 03        |
| <b>Total</b>       | <b>08</b> |

**Course Articulation Matrix**

| Course Outcomes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      | PSO's |      |
|-----------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|-------|------|
| COs             | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1  | PSO2 |
| <b>1</b>        | 3                      |     |     |     |     |     | 2   | 2   | 2   | 2    |      |       |      |
| <b>2</b>        | 3                      |     | 2   |     |     |     |     | 3   |     | 2    |      |       |      |
| <b>3</b>        | 3                      |     |     |     |     |     |     | 3   | 3   | 3    |      |       |      |

|                     |                                 |                     |                     |
|---------------------|---------------------------------|---------------------|---------------------|
| <b>Course Title</b> | <b>ACCOUNTING FOR ENGINEERS</b> |                     |                     |
| <b>Course Code</b>  | <b>24OEME63</b>                 | <b>LTPC</b>         | <b>3-0-0-3</b>      |
| <b>Exam</b>         | <b>3 Hrs</b>                    | <b>Hours / Week</b> | <b>3</b>            |
| <b>SEE</b>          | <b>50</b>                       | <b>Total hours</b>  | <b>42L+48ABL=90</b> |

**Course Objective:**

1. Understand and apply accounting concepts to prepare financial statements as per standards, and analyze financial performance to identify profitability and key insights.
2. Use accounting and budgeting tools to support decision-making, evaluate alternatives, and plan effectively for future business outcomes.

**Course Outcomes (COs)**

Upon completion of the course, students shall be able to:

| #  | Course Outcomes                                                                                                            | Mapping to POs | Mapping to PSOs |
|----|----------------------------------------------------------------------------------------------------------------------------|----------------|-----------------|
| 1. | comprehend the Indian accounting standard and international accounting standard.                                           | 2, 11          | -               |
| 2. | apply basic accounting and finance ideas, which you can then utilize when working in a managerial role in an organization. | 2, 11          | -               |
| 3. | analyze a company's financial position to uncover hidden profit opportunities.                                             | 2, 11          | -               |
| 4. | use budgetary approaches for both long-term and short-term decision making in the organization.                            | 2, 11          | -               |

**Course contents:**

|                                                                                                                                                                                                                                                                                                                           |                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Module -1</b>                                                                                                                                                                                                                                                                                                          | <b>10 Hrs.</b> |
| <b>Introduction to Financial Accounting:</b> Definition, Importance, Principles - Concepts & Conventions, Double entry bookkeeping system, Bases of accounting - Cash basis and Accrual basis, Journal, Ledger, and Trial Balance (Simple numerical problems)                                                             |                |
| <b>Module- 2</b>                                                                                                                                                                                                                                                                                                          | <b>11 Hrs.</b> |
| <b>Preparation and Interpretation of Financial Statements:</b> Objective, Importance and Limitations, Trading Account, Profit and Loss Account, Balance Sheet- Grouping of assets and liabilities, Preparation of final accounts without adjustments. Interpretation of financial statements (Simple numerical problems). |                |
| <b>Module- 3</b>                                                                                                                                                                                                                                                                                                          | <b>11 Hrs.</b> |
| <b>Financial Ratio Analysis:</b> Introduction, Objectives, Classification, Advantages, Limitations and Computation of Liquidity ratios, Profitability ratios, Leverage ratios, Activity ratios (Simple numerical problems).                                                                                               |                |
| <b>Module- 4</b>                                                                                                                                                                                                                                                                                                          | <b>10 Hrs.</b> |
| <b>Budgetary Control:</b> Budgetary Control: Meaning of a Budget, Budgetary control, Objectives of budgetary control, Essential features of Budgetary Control& merits, Steps in budgetary Control, Types of Budgets, Flexible Budget, Limitation of Budget Control (Simple numerical problems).                           |                |



**TEXTBOOKS:**

1. KakaniRamachandran, (2011), Financial Accounting for Management, 3<sup>rd</sup> edition, McGrawHill, India
2. Godwin, Alderman, Sanyal (2016), Financial ACCT - Financial Accounting (2016), Cengage Learning.

**REFERENCE BOOKS:**

1. Anthony A. Atkinson, Robert S. Kaplan, S. Mark Young, Ella Mae Matsumura, G. Arunkumar (2014), Management Accounting: Information for Decision Making and Strategy Execution, 6<sup>th</sup> edition, Pearson Education, India.
2. R.L. Gupta, V.K. Gupta: Fundamentals of Accounting: Sultan Chand & Sons: Year of Publication 1993
3. Khatri, (2011), Financial Accounting, 1<sup>st</sup> edition, McGraw Hill, India.
4. Khan M.Y, Jain P.K, (2009), Management Accounting, 5<sup>th</sup> edition, McGraw Hill, India

**Teaching -Learning– Evaluation Scheme:**

| Sl.No                                | Teaching and Learning Method          | No. of Hours/ Week | No. of Weeks | Hours/ Semester |
|--------------------------------------|---------------------------------------|--------------------|--------------|-----------------|
| 1                                    | Class Room Teaching & Learning        | 3                  | 14           | 42              |
| 2                                    | Integrated Lab Component              | -                  | -            | -               |
| 3                                    | Student Study Hours – Self Learning   | -                  | -            | -               |
| 4                                    | Tutorial Component                    | -                  | -            | -               |
| 5                                    | Activity Based Learning (ABL1 & ABL2) | -                  | -            | 41              |
| 6                                    | Evaluation of Learning Process        | -                  | -            | 07              |
| <b>Total Learning Hours/Semester</b> |                                       |                    |              | <b>90</b>       |

**Proposed Assessment Plan (for 50marks of CIE):**

| Tool             | Remarks                                                                                                                                                                                                                                                   | Marks     |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| CIE              | Three CIEs conducted for 20marks each and reduced to 10 marks                                                                                                                                                                                             | 30        |
| Activity Details | Details of activities to be conducted<br>1) Details of activity1- To prepare financial statements using, journal, ledger, and trial balance 10Marks<br>2) Details of activity2 –To solve and analyze numerical problems related to final accounts 10Marks | 20        |
| <b>Total</b>     |                                                                                                                                                                                                                                                           | <b>50</b> |

**Activities Mapped to Modules:**

| Module       | Activity Description                                                      | Hours     |
|--------------|---------------------------------------------------------------------------|-----------|
| 1            | To prepare financial statements using, journal, ledger, and trial balance | 20        |
| 2            | To solve and analyze numerical problems related to final accounts         | 21        |
| <b>Total</b> |                                                                           | <b>41</b> |

**Evaluation of Learning Process (7Hours)**

| Type of Evaluation | Hours    |
|--------------------|----------|
| Test(1,2and3)      | 3        |
| Presentation       | 1        |
| Semester End Exam  | 3        |
| <b>Total</b>       | <b>7</b> |

### Course Articulation Matrix

| Course Outcomes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      |      |      |
|-----------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| COs             | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| 1               |                        | 3   |     |     |     |     |     |     |     |      | 2    |      |      |
| 2               |                        | 3   |     |     |     |     |     |     |     |      | 2    |      |      |
| 3               |                        | 3   |     |     |     |     |     |     |     |      | 2    |      |      |
| 4               |                        | 3   |     |     |     |     |     |     |     |      | 2    |      |      |

| Course Title | Operations Research |              |               |
|--------------|---------------------|--------------|---------------|
| Course Code  | 24OEME64            | LTPC         | 3-0-0-3       |
| Exam         | 03 Hours            | Hours / Week | 3             |
| SEE          | 50 Marks            | Total hours  | 42L+48 ABL=90 |

**Course Objective:** To apply the fundamental techniques of Operations Research to formulate and solve problems involving Linear Programming and heuristic approaches.

**Course Outcomes (COs)** {with mapping shown against the **Program Outcomes (POs)**}

Upon completion of the course, students shall be able to:

| #  | Course Outcomes                                                                                                                                               | Mapping to POs | Mapping to PSOs |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------|
| 1. | formulate real-world problems as a linear programming problem and obtain the optimal solutions using graphical and analytical methods                         | 1,2,3,5        | -               |
| 2. | formulate and solve transportation and assignment problems using appropriate method                                                                           | 2,4,5,6        | -               |
| 3. | design and solve simple models of CPM, PERT, and queuing to improve decision making and develop critical thinking and objective analysis of decision problems | 2,3,5,6,10     | -               |
| 4. | select the best course of action out of several alternative courses for the purpose of achieving objectives by applying game theory and sequencing models     | 2,3,5,6,10     | -               |

#### Course contents:

| Module -1                                                                                                                                                                                                                                                                                                                                                                                                                                        | 12 Hrs. |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| <b>Introduction:</b> Linear programming, Definition, scope of Operations Research (O.R) approach and limitations of OR Models, Characteristics, and phases of OR, Mathematical formulation of L.P. Problems, Graphical solution methods.<br><b>Linear Programming Problems:</b> The simplex method - slack, surplus and artificial variables. Concept of duality, two phase method, dual simplex method.                                         |         |
| Module- 2                                                                                                                                                                                                                                                                                                                                                                                                                                        | 10 Hrs. |
| <b>Transportation Problem:</b> Formulation of transportation model, Basic feasible solution using different methods, Optimality Methods, Unbalanced transportation problem, Degeneracy in transportation problems, Applications of Transportation problems<br><b>Assignment Problem:</b> Formulation of Assignment Problem, unbalanced assignment problem, Applications of Assignment Problem, Travelling salesman problem and its applications. |         |
| Module- 3                                                                                                                                                                                                                                                                                                                                                                                                                                        | 10 Hrs. |
| <b>PERT-CPM Techniques:</b> Network construction, determining critical path, floats, scheduling by network, project duration, variance under probabilistic models, prediction of date of completion.<br><b>Queuing Theory:</b> Queuing system and their characteristics. The M/M/1 Queuing system, Steady state performance analysing of M/M/ 1 and M/M/C queuing models.                                                                        |         |
| Module- 4                                                                                                                                                                                                                                                                                                                                                                                                                                        | 10 Hrs. |
| <b>Game Theory:</b> Formulation of games, Two Person-Zero sum game, games with and without saddle point, Graphical solution (2x n, m x 2 game), dominance property.<br><b>Sequencing:</b> Johnson's algorithm, n - jobs to 2 machines, n jobs 3machines, n jobs m machines without passing sequence, 2 jobs n machines with passing, Graphical solutions priority rules.                                                                         |         |

**TEXT BOOKS:**

1. Taha H. A, Operations Research and Introduction, Pearson Education edition, 8<sup>th</sup> edition, 2021, ISBN: 9780131889231.
2. Operations Research, S. D. Sharma –KedarnathRamnath& Co, 2022, ISBN: 1234567142552

**REFERENCE BOOKS:**

1. AM Natarajan, P. Balasubramani and A Tamilaravari, Operation Research, Pearson 2019 9788131700006.
2. Hiller and Liberman, Introduction to operation research, McGraw Hill. 5<sup>th</sup> edition 2021, ISBN: 978-0077298340.
3. Ravindran, Phillips and Solberg, Operations Research: Principles and practice: Wiley India Ltd, 2nd Edition 2007 ISBN: 9788126512560
4. Prem Kumar Gupta, D S Hira, S Chand Publications, Operations Research, New Delhi, 2017, ISBN: 9788121941006

**Teaching –Learning– Evaluation Scheme:**

| Sl.No                                | Teaching and Learning Method          | No. of Hours/ Week | No. of Weeks | Hours/ Semester |
|--------------------------------------|---------------------------------------|--------------------|--------------|-----------------|
| 1                                    | Class Room Teaching & Learning        | 3                  | 14           | 42              |
| 2                                    | Integrated Lab Component              | -                  | -            | -               |
| 3                                    | Student Study Hours – Self Learning   | -                  | -            | -               |
| 4                                    | Tutorial Component                    | -                  | -            | -               |
| 5                                    | Activity Based Learning (ABL1 & ABL2) | -                  | -            | 41              |
| 6                                    | Evaluation of Learning Process        | -                  | -            | 07              |
| <b>Total Learning Hours/Semester</b> |                                       |                    |              | <b>90</b>       |

**Proposed Assessment Plan (for 50marks of CIE):**

| Tool             | Remarks                                                                                                                                                                                                                                                                                                                                               | Marks     |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| CIE              | Three CIEs conducted for 20marks each and reduced to 10 marks                                                                                                                                                                                                                                                                                         | 30        |
| Activity Details | Details of activities to be conducted<br>1) Details of activity1-To write program to solve OR problems and to compare with theoretical solution and present the report -10Marks<br>2) Details of activity2 –Solve numerical problems using Open Source software such as A to Z Math, R- Program and Mini tab Software and present the report -10Marks | 20        |
| <b>Total</b>     |                                                                                                                                                                                                                                                                                                                                                       | <b>50</b> |

**Activity-Based Learning (ABL - 48 Hours)**

| Module       | Activity Description                                                                                                     | Hours          |
|--------------|--------------------------------------------------------------------------------------------------------------------------|----------------|
| 1            | To write program using programming language and to compare the numerical solutions obtained by analytical method.        | 15             |
| 2            | To Solve numerical problems of operations research using open source software and compare the analytical solutions.      | 11             |
| 3            | To develop different apps using the concept of operations research to solve real applications related to societal issue. | 15             |
| <b>Total</b> |                                                                                                                          | <b>41 hrs.</b> |

**Evaluation of Learning Process (6 Hours)**

| Type of Evaluation | Hours    |
|--------------------|----------|
| Test(1,2and3)      | 3        |
| Presentation       | 1        |
| Semester End Exam  | 3        |
| <b>Total</b>       | <b>7</b> |

**Course Articulation Matrix**

| Course Outcomes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      |      |      |
|-----------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| COs             | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| 1               | 2                      | 3   | 2   |     | 2   |     |     |     |     |      |      |      |      |
| 2               |                        | 3   |     | 2   | 2   | 2   |     |     |     |      |      |      |      |
| 3               |                        | 3   | 2   |     | 2   | 2   |     |     |     | 2    |      |      |      |
| 4               |                        | 3   | 2   |     | 2   | 2   |     |     |     | 2    |      |      |      |

|                     |                                              |                     |                     |
|---------------------|----------------------------------------------|---------------------|---------------------|
| <b>Course Title</b> | <b>INDUSTRIAL ENGINEERING AND ERGONOMICS</b> |                     |                     |
| <b>Course Code</b>  | <b>24OEME65</b>                              | <b>LTPC</b>         | <b>3-0-0-3</b>      |
| <b>Exam</b>         | <b>3 Hours</b>                               | <b>Hours / Week</b> | <b>03 Hours</b>     |
| <b>SEE</b>          | <b>50Marks</b>                               | <b>Total hours</b>  | <b>42L+48ABL=90</b> |

**Course objectives:** To provide basic knowledge of productivity and method study, work measurement and ergonomics in various sectors and its effectiveness in improvement of productivity.

**Course Outcomes (COs)** {with mappings shown against the **Program Outcomes (POs)**} Upon successful completion of this course, the student shall be able to:

| #  | Course Outcomes                                                                                                         | Mapping to POs | Mapping to PSOs |
|----|-------------------------------------------------------------------------------------------------------------------------|----------------|-----------------|
| 1. | Explain the fundamental concepts of productivity and work study                                                         | 1, 3,8,9       | -               |
| 2. | Compare and prepare the charts for the existing method and new / proposed method to identify the unnecessary movements. | 2, 3,8,9       | -               |
| 3. | Apply the concepts of work measurement to solve problems related to work measurement and performance of workers         | 2, 6,8,9       | -               |
| 4. | apply the ergonomic concepts in design of new systems, displays and controls                                            | 3, 6,8,9       | -               |

#### **COURSE CONTENTS:**

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |                |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|----------------|
| <b>Module– 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  | <b>11Hrs.</b>  |
| <b>Productivity and work study:</b> Definition of productivity, Production and productivity, expectations from productivity, benefits from productivity, productivity measures, advantages and limitations of productivity measures, Factors affecting the productivity, Productivity improvement programmes (Simple Problems). Basic work content. Definition, objective and scope of work-study. Human factors in work study. Work study and management, work study and supervision, work study and worker. |  |                |
| <b>Module– 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  | <b>10 Hrs.</b> |
| <b>Method Study and Tools for Method study:</b> Definition, objective and scope of method study, activity recording and exam aids. Charts to record moments in shop operation – process charts, flow process charts, travel chart and multiple activity charts (Problems). Charts to record moment at workplace – principles of motion economy, classification of moments, two handed process chart, SIMO chart, (Problems)                                                                                   |  |                |
| <b>Module– 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  | <b>10 Hrs.</b> |
| <b>Work Measurement:</b> Definition, objectives, preparing to measure process work, techniques of work measurement, types of elements, time study equipment's, performance rating, allowances, computation of standard time, comparison of various techniques, work sampling, synthetic data, predetermined motion time analysis (PMTS)                                                                                                                                                                       |  |                |
| <b>Module– 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  | <b>11Hrs.</b>  |
| <b>Ergonomics and Design of Man-Machine System:</b> Introduction, areas of study under ergonomics, System approach to ergonomics model, Man-machine system. Components of man-machine system and their functions Quantitative, qualitative representation and alphanumeric displays. Controls and their design criteria, Control types, Relation between controls and displays. Design of workplace.                                                                                                          |  |                |



**MALNAD COLLEGE OF ENGINEERING, HASSAN**  
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**SELFSTUDY:**

1. Study of occupational loads
2. Study in detail about working space and working environment.
3. Working environment factors
4. Anthropometry and its importance
5. Risk factors for musculoskeletal disorders in the workplace
6. Predetermined motion time system techniques and development of PMT system

**TEXT BOOKS:**

1. Industrial Engineering and Production Management, Mart and T Telsang, 3<sup>rd</sup> edition, 2018.  
BN 978-93-525-3379-4
2. Work Study & Ergonomics, Suresh Dalela & Saurabh, standard publishers & distributors.  
BN 9780850660085

**REFERENCE BOOKS:**

1. Introduction to Ergonomics, R.C. Bridger, McGraw Hill Publications.  
BN 978-0-8493-7309-0
2. Industrial Design for Engineers, Mayall W.H. London Hiffie Books Ltd., 1988.  
BN -10-0592042057
3. Human Factor Engineering: Sanders & McCormick McGraw Hill Publications.  
ISBN 0840316240

**Teaching -Learning– Evaluation Scheme:**

| Sl.No                                  | Teaching and Learning Method          | No. of Hours/ Week | No. of Weeks | Hours/ Semester |
|----------------------------------------|---------------------------------------|--------------------|--------------|-----------------|
| 1                                      | Class Room Teaching                   | 3                  | 14           | 42              |
| 2                                      | Integrated Lab Component              | -                  | -            | -               |
| 3                                      | Student Study Hours – Self Learning   | -                  | -            | -               |
| 4                                      | Tutorial component                    | -                  | -            | -               |
| 5                                      | Activity Based Learning (ABL1 & ABL2) | -                  | -            | 40              |
| 6                                      | Evaluation of Learning Process        | -                  | -            | 08              |
| <b>Total Learning Hours / Semester</b> |                                       |                    |              | <b>90</b>       |

**Assessment Plan (for 50 marks of CIE):**

| Tool             | Remarks                                                                                                                                                                                                                                                                                                                      | Marks     |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| CIE              | Three CIEs conducted for 20 marks each and reduced to 10 marks                                                                                                                                                                                                                                                               | 30        |
| Activity Details | Details of activities to be conducted<br>1) Details of activity 2 - Conduct quiz on each module and take the average marks. --05 Marks.<br>2) Details of activity 1 - The surprise test will be conducted on the self-study component. – 05 Marks.<br>3) Details of activity 3 – Conduct a case study on any topic- 10 Marks | 20        |
| <b>Total</b>     |                                                                                                                                                                                                                                                                                                                              | <b>50</b> |



**MALNAD COLLEGE OF ENGINEERING, HASSAN**  
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Activity Based Learning

| SL no | Teaching and learning                                                                                                                                                                                                                                                                                                                                                                                                 | Hours |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1     | <b>Activity for industrial engineering and ergonomics</b> <ol style="list-style-type: none"> <li>1. Work Study (Method Study and Work Measurement)</li> <li>2. Time Study and Productivity Analysis</li> <li>3. Workplace Ergonomics Fundamentals</li> <li>4. Ergonomic Risk Assessment</li> <li>5. Workplace Layout and Material Handling</li> <li>6. Practical Workplace Observation and Data Collection</li> </ol> | 40    |

**Evaluation of Learning Process (08 Hours)**

| Type of Evaluation | Hours     |
|--------------------|-----------|
| Test (1, 2 and 3)  | 03        |
| Quiz               | 01        |
| Presentation       | 01        |
| Semester End Exam  | 03        |
| <b>Total</b>       | <b>08</b> |

| Course Outcomes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      |      |      |
|-----------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| COs             | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1             | 3                      |     | 2   |     |     |     |     | 2   | 2   |      |      |      |      |
| CO2             |                        | 2   | 2   |     |     |     |     | 2   | 2   |      |      |      |      |
| CO3             |                        | 2   |     |     |     | 2   |     | 2   | 2   |      |      |      |      |
| CO4             |                        |     | 2   |     |     | 2   |     | 2   | 2   |      |      |      |      |





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|                     |                                                     |                     |                     |
|---------------------|-----------------------------------------------------|---------------------|---------------------|
| <b>Course Title</b> | <b>Occupational Health &amp; Safety Engineering</b> |                     |                     |
| <b>Course Code</b>  | <b>25OEME66</b>                                     | <b>LTPC</b>         | <b>3-0-0-3</b>      |
| <b>Exam</b>         | <b>03 Hours</b>                                     | <b>Hours / Week</b> | <b>03</b>           |
| <b>SEE</b>          | <b>50 Marks</b>                                     | <b>Total hours</b>  | <b>42L+48ABL=90</b> |

**Course objectives:** To apply the basic concept of occupational health & safety standards in workplace scenario.

**Course Outcomes (COs)**

Upon completion of the course, students shall be able to:

| #  | Course Outcomes                                                                                                                                                   | Mapping to POs | Mapping to PSOs |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------|
| 1. | Explain the basic concepts of occupational hazards, accident causation theories, safety policies, and investigation methods used in industrial safety management. | 1,6            | -               |
| 2. | Analyze workplace hazards using ergonomic principles, human error analysis, and hazard identification techniques such as fault tree analysis.                     | 2,7            | -               |
| 3. | Apply fire safety, electrical safety standards, lockout/tagout procedures, and process safety management techniques to prevent industrial accidents.              | 3,6            | -               |
| 4. | Evaluate occupational health issues, PPE usage, environmental management practices, safety audits, and legal regulations in industries.                           | 6,7,11         | -               |

**Course Contents:**

|                                                                                                                                                                                                                   |                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
| <b>Module – 1</b>                                                                                                                                                                                                 | <b>10 Hrs.</b> |
| <b>Occupational Hazard &amp; Control Principles:</b> Safety history, national safety policies, OSHA laws, accident causation theories, investigation methods, and supervisory roles in safety management.         |                |
| <b>Module – 2</b>                                                                                                                                                                                                 | <b>10 Hrs.</b> |
| <b>Ergonomics &amp; Hazard Analysis:</b> Ergonomic task analysis, workstation design, visual ergonomics, hazard cognition, human error analysis, fault tree analysis, and emergency response planning.            |                |
| <b>Module – 3</b>                                                                                                                                                                                                 | <b>11Hrs.</b>  |
| <b>Fire &amp; Electrical Safety:</b> Fire triangle, extinguishing methods, electrical safety standards, lockout/tagout procedures, product safety standards and Process Safety Management (PSM).                  |                |
| <b>Module - 4</b>                                                                                                                                                                                                 | <b>11Hrs</b>   |
| <b>Health &amp; Environmental Considerations:</b> Types of occupational diseases, personal protective equipment (PPE), safety in confined spaces, hazardous waste management, and environmental management plans. |                |
| <b>Safety Management &amp; Regulations:</b> Safety audits, legal aspects, safety training, and specific industry hazard controls (e.g., scaffold/ladder safety).                                                  |                |

|                                                                                                                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------|
| <b>SELF STUDY:</b> Workplace ergonomics, fire safety, workplace violence prevention, employee health resources, and environmental safety. |
|-------------------------------------------------------------------------------------------------------------------------------------------|



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**TEXT BOOKS:**

1. Goetsch D.L., “Occupational Safety and Health for Technologists”, Engineers and Managers”, Prentice Hall.

**REFERENCE BOOKS:**

1. Heinrich H.W., “Industrial Accident Prevention”, McGraw Hill Publication, Network.
2. Colling D.A., “Industrial Safety Management and Technology”, Prentice Hall, New Jersey.
3. Della D.E., and Giustina, “Safety and Environmental Management”, Van Nostrand Reinhold International Thomson Publishing Inc.
4. CPHEEO, Manual on Sewerage and Sewage Treatment, M/s.Jain Book Agency, c-9, Connaught place, New Delhi.
5. National Safety Council and Associate (Data) Publishers Pvt. Ltd., “Industrial Safety and Pollution Control Handbook”

| Sl. No                                 | Teaching and Learning Method          | No. of Hours/Week | No. of Weeks | Hours/ Semester |
|----------------------------------------|---------------------------------------|-------------------|--------------|-----------------|
| 1                                      | Class Room Teaching                   | 3                 | 14           | 42              |
| 2                                      | Integrated Lab Component              | -                 | -            | -               |
| 3                                      | Student Study Hours – Self Learning   | -                 | -            | -               |
| 4                                      | Tutorial component                    | -                 | -            | -               |
| 5                                      | Activity Based Learning (ABL1 & ABL2) | -                 | -            | 42              |
| 6                                      | Evaluation of Learning Process        | -                 | -            | 06              |
| <b>Total Learning Hours / Semester</b> |                                       |                   |              | <b>90</b>       |

1. Case studies and prepare a report (Group Activity)

| <b>ABL1 (20 Hours): Case Studies</b> | <b>Hours</b> |
|--------------------------------------|--------------|
| Hazard Identification Survey         | 05           |
| OSHA & Factory Act                   | 05           |
| Accident Analysis Simulation         | 05           |
| Risk Assessment of Workshop          | 05           |
| PPE Identification & Usage           | 02           |
| <b>Total</b>                         | <b>22</b>    |

2. Industrial visit and prepare a report(Group Activity)

| <b>ABL2 (08 Hours): Case Studies</b> | <b>Hours</b> |
|--------------------------------------|--------------|
| Fire Drill & Extinguisher Demo       | 05           |
| Workplace Ergonomic Assessment       | 05           |
| Safety Audit Exercise                | 05           |
| Waste Management Study               | 05           |
| <b>Total</b>                         | <b>20</b>    |



**MALNAD COLLEGE OF ENGINEERING, HASSAN**  
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**COURSE ATRICULATION MATRIX**

| Course Out comes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      |      |      |
|------------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| COs              | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1              | 3                      |     |     |     |     | 2   |     |     |     |      |      |      |      |
| CO2              |                        | 3   |     |     |     |     | 2   |     |     |      |      |      |      |
| CO3              |                        |     | 3   |     |     | 3   |     |     |     |      |      |      |      |
| CO4              |                        |     |     |     |     | 3   | 3   |     |     |      | 2    |      |      |



**MALNAD COLLEGE OF ENGINEERING, HASSAN**  
(An Autonomous Institution Affiliated to VTU, Belgaum)

**PROJECTWORK PHASE-1**

**24ME605**

Exam Hours: 3

SEE: 50 Marks

**LTPC: 0-0-4-2**

Hours / Week: 04

Total hours: 26

**Course Objectives:** To take part in a group to demonstrate the acquired skill & knowledge gained to identify, formulate, analyze, evaluate and to provide meaningful engineering solutions to Industrial/societal needs.

**Course Outcomes (COs)** {with mappings shown against the **Program Outcomes**

**(POs)** Upon successful completion of this course, the student shall be able

to:

| #  | Course Outcomes                                                     | Mapping to POs          | Mapping to PSOs |
|----|---------------------------------------------------------------------|-------------------------|-----------------|
| 1. | Identify a problem from the available literature and societal needs | 1,2,3,4,5,6,7,8,9,10,11 | 1, 2            |

**SCHEME OF EVALUATION**

| PHASE -I |                                              | MAX MARKS:            |
|----------|----------------------------------------------|-----------------------|
| Sl. No.  | Particulars                                  | Distribution of Marks |
| 1.       | Literature Survey/Problem Declaration (Team) | 20                    |
| 2.       | Presentation skill (Individual)              | 20                    |
| 3.       | Viva voce (Individual)                       | 10                    |

SEE is conducted for 50 marks by internal and external examiners appointed by the Dean (Exams) on recommendations of the HOD

| Examination | Maximum marks | Minimum marks to qualify |
|-------------|---------------|--------------------------|
| CIE         | 50            | 20                       |
| SEE         | 50            | 20                       |

**COURSE ARTICULATION MATRIX**

| Course Outcomes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      |      |      |
|-----------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| COs             | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1             | 3                      | 3   | 3   | 2   | 2   | 2   | 2   | 2   | 3   | 3    | 2    |      |      |



**MALNAD COLLEGE OF ENGINEERING, HASSAN**  
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**RUBRICS FOR PROJECT WORK (PHASE -I)**

**PHASE – I (100 Marks)**

| <b>Criteria/<br/>Grading</b> | <b>Literature Survey/<br/>Problem<br/>Identification (40)</b>                                                                                                  | <b>Presentation skill<br/>(40)</b>                                                                                                                                                                              | <b>Viva voce<br/>(20)</b>                                                          |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|
| <b>Excellent(37-40)</b>      | Outstanding investigation in all aspects. The project's purpose and need are explained in great detail.                                                        | A well-planned and executed presentation and demo that clearly demonstrated the product's value. Presentations are well-prepared and delivered. Maintaining eye contact with the Audience and speaking clearly. | Outstanding Contribution demonstrating the individual's dependence on the project. |
| <b>Good(32-36)</b>           | A well-researched project with depth and thoroughness, good research planning, and ample referencing. Collects a lot of data and studies the Existing systems. | Very good demonstration. Detailed description of the project and its issues. Presentations are well-prepared and delivered. Good spoken language but less eye contact with audience.                            | Strong contribution, as evidenced by the overall quality of the work.              |
| <b>Average(16-30)</b>        | The study is organized. Coverage is suitable and referenced. Moderate analysis of existing systems; gathers Basic data.                                        | Timed presentation, demo with student explaining what they learned. Presentations have good content but poor delivery. Few eye contacts and a muddled voice.                                                    | Some contribution as reflected in overall work.                                    |
| <b>Poor(0-15)</b>            | Minimal research, minimal referencing, moderate explanation of the project's Purpose and need.                                                                 | The student can't articulate the project development. Presentations are inappropriate and poorly delivered. Poor eye contact and Voice clarity.                                                                 | No Contribution.                                                                   |



**MALNAD COLLEGE OF ENGINEERING, HASSAN**  
(An Autonomous Institution Affiliated to VTU, Belgaum)

| Course Title | DESIGN LABORATORY |              |              |
|--------------|-------------------|--------------|--------------|
| Course Code  | 23ME606           | LTPC         | 0-0-2-1      |
| Exam         | 03 Hours          | Hours / Week | 02           |
| SEE          | 50 Marks          | Total hours  | 28P+02ABL=30 |

**Course objectives:** To provide students with the necessary skills to conduct experiments, collect data, perform analysis and interpret results to draw valid conclusions through standard test procedures to evaluate kinematic and dynamic characteristics of machine elements.

**Course Outcomes (COs)** {with mapping shown against the **Program Outcomes (POs)**}

Upon completion of the course, students shall be able to:

| COs | Course Outcomes                                                                                                                         | Mapping to POs | Mapping to PSOs |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------|----------------|-----------------|
| 1   | determine the behavior of undamped & damped system for longitudinal, torsional and forced vibrations in a single degree freedom system. | 1,2,9,10       | -               |
| 2   | conduct experiments on governors, gyroscope, balancing of rotating masses and pressure distribution around journal bearing.             | 1,2,9,10       | -               |
| 3   | determine the stresses & strains in a member subjected to combined Loading using rosettes and photo elasticity.                         | 1,2,9,10       | -               |

**Course Contents:**

1. Determination of equilibrium speed, sensitiveness, power and effort of centrifugal governors.
2. Conduct experiments on gyroscope.
3. Experiment on Balancing of rotating masses.
4. Determination of pressure distribution in journal bearing
5. Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in a single degree freedom system.
6. Experiments on longitudinal, Torsional and forced vibrations.
7. Determination of critical speed of a rotating shaft.
8. Determination of principal stresses and strains in a member subjected to combined loading using rosettes.
9. Demonstration of stress concentration using photo elasticity for simple components like plate with a hole under tension or bending, circular disk with circular hole under compression, 2 D crane hook.
10. Determination of fringe constant of photo elastic material using
  - a) Circular disc subjected to diametral compression.
  - b) Pure bending specimen (four-point bending).



**MALNAD COLLEGE OF ENGINEERING, HASSAN**  
(An Autonomous Institution Affiliated to VTU, Belgaum)

**SEE Scheme:**

|        |                                                |          |
|--------|------------------------------------------------|----------|
| 1.     | One experiment from either 1 to 5              | 15 Marks |
| 2.     | Any one performance test either from 6, 7 or 8 | 25 Marks |
| 3.     | Viva Voce                                      | 10 Marks |
| Total: |                                                | 50 Marks |

**Teaching - Learning – Evaluation Scheme:**

| Sl. No                                 | Teaching and Learning Method        | No. of Hours/Week | No. of Weeks | Hours/ Semester |
|----------------------------------------|-------------------------------------|-------------------|--------------|-----------------|
| 1                                      | Class Room Teaching & Learning      | -                 | -            | -               |
| 2                                      | Practical                           | 2                 | 14           | 28              |
| 2                                      | Student Study Hours – Self Learning | -                 | -            | -               |
| 3                                      | Evaluation of Learning Process      | -                 | -            | -               |
| 4                                      | Activity Based Learning (ABL)       | -                 | -            | 02              |
| <b>Total Learning Hours / Semester</b> |                                     |                   |              | <b>30</b>       |

**Activity Based Learning (02 Hours)**

**ABL:** Students will perform experiments and analyze the behavior of centrifugal governors to determine equilibrium speed, sensitiveness, power, and controlling effort, and interpret their influence on engine performance. (02Hrs)

**COURSE ATRICULATION MATRIX**

| Course Outcomes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      |      |      |
|-----------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| COs             | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1             | 3                      | 3   |     |     |     |     |     |     | 2   | 2    |      |      |      |
| CO2             | 3                      | 3   |     |     |     |     |     |     | 2   | 2    |      |      |      |
| CO3             | 3                      | 3   |     |     |     |     |     |     | 2   | 2    |      |      |      |
| CO4             | 3                      | 3   |     |     |     |     |     |     | 2   | 2    |      |      |      |



**MALNAD COLLEGE OF ENGINEERING, HASSAN**  
(An Autonomous Institution Affiliated to VTU, Belgaum)

|                                                                                                                                                                                                                                                       |                                                         |                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|------------------|
| Course Title                                                                                                                                                                                                                                          | Analytical Ability and Soft Skills                      |                  |
| Course Code                                                                                                                                                                                                                                           | 24ASK                                                   | L-T-P-C =0-0-2-1 |
| Exam Hrs.                                                                                                                                                                                                                                             | 1                                                       | Hours/Week: 2    |
| SEE                                                                                                                                                                                                                                                   | 50Marks                                                 | Total Hours: 30  |
| CourseObjective:To Enhance problem solving skills and communication skills                                                                                                                                                                            |                                                         |                  |
| CourseOutcomes(COs):Uponcompletionofthecourse,studentsshallbeableto:                                                                                                                                                                                  |                                                         |                  |
| #                                                                                                                                                                                                                                                     | Course Outcomes                                         | Mapping to POs   |
| 1.                                                                                                                                                                                                                                                    | Apply methods to solve numerical and reasoning problems | 2,3              |
| 2.                                                                                                                                                                                                                                                    | Lead a team in corporate offices                        | 8,9              |
| 3.                                                                                                                                                                                                                                                    | Communicate effectively in professional ambience        | 10               |
| Course Contents:                                                                                                                                                                                                                                      |                                                         |                  |
| MODULE–1                                                                                                                                                                                                                                              |                                                         |                  |
| Hard Skills: Speed/Distance, Probability, Permutations/Combinations, Profit/Loss, Simple Interest/Compound Interest, Number theories, Number/Letter series, Coding/Decoding, Blood relations, Directions, Clock, Calendar. Logical reasoning (12Hrs.) |                                                         |                  |
| MODULE–2                                                                                                                                                                                                                                              |                                                         |                  |
| Soft Skills: Basic grammar, Spotting errors, Sentence formation, Email writing, Public speaking, Client communication, Leadership, Managerial skills, Stress management, Presentation Skills (06Hrs)                                                  |                                                         |                  |
| MODULE–3                                                                                                                                                                                                                                              |                                                         |                  |
| Technical Skills: Review of C programming, Simple coding, Syntax rules, MCQs in C language. (06 Hrs.)                                                                                                                                                 |                                                         |                  |
| MODULE–4                                                                                                                                                                                                                                              |                                                         |                  |
| Activities: GD, JAM, Mock Interview, Pick and speak, Presentation(06 Hrs.)                                                                                                                                                                            |                                                         |                  |

**COURSE ATRICULATION MATRIX**

| Course Outcomes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      |      |      |
|-----------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
| COs             | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1             |                        | 2   | 3   |     |     |     |     |     |     |      |      |      |      |
| CO2             |                        |     |     |     |     |     |     | 1   | 3   |      |      |      |      |
| CO3             |                        |     |     |     |     |     |     |     |     | 3    |      |      |      |





**MALNAD COLLEGE OF ENGINEERING, HASSAN**  
(An Autonomous Institution Affiliated to VTU, Belgaum)

|                     |                                |                     |                        |
|---------------------|--------------------------------|---------------------|------------------------|
| <b>Course Title</b> | <b>SUSTAINABLE ENGINEERING</b> |                     |                        |
| <b>Course Code</b>  | <b>24ME608</b>                 | <b>LTPC</b>         | <b>0-0-2-1</b>         |
| <b>Exam</b>         | <b>1 Hour (CIE only)</b>       | <b>Hours / Week</b> | <b>2</b>               |
|                     |                                | <b>Total hours</b>  | <b>2L+14P+14ABL=30</b> |

**Course Objective:**

To equip students with the knowledge to design, develop, and evaluate engineering solutions that are environmentally responsible, economically viable, and socially equitable.

**Course Outcomes (COs)**

Upon completion of the course, students shall be able to:

| #  | Course Outcomes                                                                                               | Mapping to POs | Mapping to PSOs |
|----|---------------------------------------------------------------------------------------------------------------|----------------|-----------------|
| 1. | Enumerate the relevance and the concept of sustainability and the global initiatives in this direction        | 6, 7, 11       | -               |
| 2. | Explain the different types of environmental pollution problems and their sustainable solutions.              | 6, 7, 11       | -               |
| 3. | Outline the concepts related to conventional and non-conventional energy                                      | 6, 7, 11       | -               |
| 4. | Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles. | 6, 7, 11       | -               |

**Course contents:**

|                                                                                                                                                                                                                                             |               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| <b>Module -1</b>                                                                                                                                                                                                                            | <b>6 Hrs.</b> |
| <b>Sustainability</b> -need and concept, technology and sustainable development-Natural resources and their pollution, Carbon credits, zero waste concept.                                                                                  |               |
| <b>Module- 2</b>                                                                                                                                                                                                                            | <b>6 Hrs.</b> |
| <b>Environmental Pollution:</b> Air Pollution and its effects, Water pollution and its sources, zero waste concept and 3 R concepts in solid waste management; Greenhouse effect, Global warming, Climate change.                           |               |
| <b>Module- 3</b>                                                                                                                                                                                                                            | <b>7 Hrs.</b> |
| <b>Resources and its utilization:</b> Basic concepts of Conventional and non-conventional energy, General idea about solar energy, Fuel cells, Wind energy, Small hydro plants, biofuels, Energy derived from oceans and Geothermal energy. |               |
| <b>Module- 4</b>                                                                                                                                                                                                                            | <b>7 Hrs.</b> |
| <b>Sustainability practices:</b> Basic concept of sustainable habitat, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable Urbanization, Sustainable cities, Sustainable transport                        |               |

**Self Study Component:**

**Case studies on the following:**

Air Pollution and its effects, Water pollution and its sources, zero waste concept, Greenhouse effect, Global warming, Climate change, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable Urbanization, Sustainable cities, Sustainable transport



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**Text Books:**

1. Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
2. Bradley.A.S;Adebayo,A.O.,Maria,P.Engineering applications in sustainable design and development, Cengage learning.
3. Environment Impact Assessment Guidelines, Notification of Government of India, 2006

**Reference Books:**

1. Mackenthun, K.M., Basic Concepts in Environmental Management, Lewis Publication, London, 1998
2. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System
3. Nibin Chang, Systems Analysis for Sustainable Engineering: Theory and Applications, McGraw-Hill Professional.
4. Twidell, J.W. and Weir, A.D., Renewable Energy Resources, English Language Book Society (ELBS).
5. Purohit, S. S., Green Technology - An approach for sustainable environment, Agrobios Publication Erach Bharucha, —Text Book of Environmental Studies, for UGC, University press, 2005

**Teaching -Learning- Evaluation Scheme:**

| Sl.No                                | Teaching and Learning Method       | No. of Hours/ Week | No. of Weeks | Hours/ Semester |
|--------------------------------------|------------------------------------|--------------------|--------------|-----------------|
| 1                                    | Class Room Teaching & Learning     | -                  | -            | 2               |
| 2                                    | Practical                          | -                  | -            | -               |
| 3                                    | Student Study Hours- Self Learning | -                  | -            | -               |
| 4                                    | Evaluation of Learning Process     | 1                  | 14           | 14              |
| 5                                    | Activity Based Learning (ABL)      | 1                  | 14           | 14              |
| <b>Total Learning Hours/Semester</b> |                                    |                    |              | <b>30</b>       |

**Proposed Assessment Plan (for 50 marks of CIE):**

| Tool         | Remarks                                                         | Marks |
|--------------|-----------------------------------------------------------------|-------|
| Presentation | Presentation on case studies related to sustainable engineering | 50    |

**Evaluation of Learning Process:**

| Type of Evaluation | Hours |
|--------------------|-------|
| Presentation       | 14    |



**MALNAD COLLEGE OF ENGINEERING, HASSAN**  
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**Course Articulation Matrix**

| Course Out comes | Program Outcomes [POs] |     |     |     |     |     |     |     |     |      |      |      |      |
|------------------|------------------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|
|                  | PO1                    | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 |
| CO1              |                        |     |     |     |     | 3   | 2   |     |     |      | 1    |      |      |
| CO2              |                        |     |     |     |     | 3   | 2   |     |     |      | 1    |      |      |
| CO3              |                        |     |     |     |     | 3   | 2   |     |     |      | 1    |      |      |
| CO4              |                        |     |     |     |     | 3   | 2   |     |     |      |      |      |      |