THE VISION OF THE DEPARTMENT OF MECHANICAL ENGINEERING

We, at the Department of Mechanical Engineering, Anna University shall strive hard to impart knowledge and state-of-the-art training to our students and expose them to broad areas of Mechanical Engineering, namely Design, Manufacturing, Energy, Thermal Sciences and currently related interdisciplinary areas, so that they can later practice their profession at home or abroad keeping in mind the needs and concern of the society they represent, safeguarding values, ethics and be instrumental in bringing about an overall technological development.

THE MISSION OF THE DEPARTMENT OF MECHANICAL ENGINEERING

1. To deliver knowledge in Mechanical Engineering and Materials Science and Engineering with high educational standards so that the outgoing students are employable and globally competitive.

2. To produce graduate and post graduate engineers with core competency as well as relevant software skills and social responsibility.

3. To be dynamic in imparting knowledge to students depending upon the changing national and International needs
ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM
M.E. ENGINEERING DESIGN (FULL – TIME)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):
Enable the students:
1. To develop an aptitude to use engineering principles to conceptualize, create, model, test and evaluate designs within the context of local and global needs.
2. To become effective and excellent collaborators and innovators, participating in efforts to address and provide solutions to social and technical challenges.
3. To develop innovative technologies and find solutions to contemporary issues in Engineering Design using fundamental principles in combination with modern engineering tools and methods.
4. To pursue advanced education, research and development and other creative/innovative efforts in their professional career.

PROGRAMME OUTCOMES (POS):
After successful completion of Product Design & Development programme, Graduates will exhibit ability to:
1. Apply knowledge of mathematics, basic science and engineering science.
2. Identify, formulate and solve engineering problems.
3. Design a system or process to improve its performance, satisfying its constraints.
4. Conduct experiments & collect, analyze and interpret the data.
5. Apply various tools and techniques to improve the efficiency of the system.
6. Conduct themselves to uphold the professional and social obligations.
7. Design the system with environment consciousness and sustainable development.
8. Interact in industry, business and society in a professional and ethical manner.
11. Implement cost effective and improved system.
12. Continue professional development and learning as a life-long activity.

PROGRAMME SPECIFIC OUTCOMES (PSOs):
1. Provide optimized solution to problems during design phase of product using advanced CAD / CAE / FEA tools and mathematical models.
2. Identify the space of work in different areas of research including inter disciplinary fields and provide innovative solutions using the design paradigms.
3. Become a successful professional with his/her acquired creative design skills and knowledge through which they would provide impetus to develop solutions that would lead to next generation technologies.

MAPPING PEO’S WITH PO’S

<table>
<thead>
<tr>
<th>PROGRAMME OUTCOMES</th>
</tr>
</thead>
<tbody>
<tr>
<td>PEO’S</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
</tbody>
</table>
# MAPPING OF COURSE OUTCOME AND PROGRAMME OUTCOMES

<table>
<thead>
<tr>
<th>SUBJECT</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sem I</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer Applications in Design</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Advanced Mechanics of Materials</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vibration Analysis and Control</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced Mechanisms in Design</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program Elective-I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Research Methodology and IPR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Audit course-I</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAD and Design for Manufacture and Assembly Laboratory</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise, Vibration and Harshness Laboratory</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sem II</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finite Element Methods in Mechanical Design</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Integrated Product Design and Process Development</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Designing with Advanced Materials</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program Elective-II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program Elective-III</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program Elective-IV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Audit Course-II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simulation and Analysis Laboratory</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product Design Laboratory</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sem III</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program Elective-V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program Elective-VI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open Elective</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical Seminar</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dissertation-I</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Sem IV</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dissertation-II</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>ELECTIVES</strong></td>
<td>PO1</td>
<td>PO2</td>
<td>PO3</td>
<td>PO4</td>
<td>PO5</td>
<td>PO6</td>
<td>PO7</td>
<td>PO8</td>
<td>PO9</td>
<td>PO10</td>
<td>PO11</td>
<td>PO12</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>------</td>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>Design for Sustainability</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Composite Materials and Mechanics</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Design of Hydraulic and Pneumatic Systems</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Surface Engineering</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Advanced Machine Tool Design</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Product Lifecycle Management</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Optimization Techniques in Design</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Quality Concepts in Design</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Mechanical Measurements and Analysis</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Vehicle Dynamics</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Engineering Fracture Mechanics</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Bearing Design and Rotor Dynamics</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Solid Freeform Manufacturing</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Advanced Finite Element Analysis</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Design of Hybrid and Electric Vehicles</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Tribology in Design</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Material Handling Systems and Design</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Creativity and Innovation</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Computational Fluid Dynamics</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
# Anna University, Chennai

## University Departments

## Regulations – 2019

### Choice Based Credit System

#### Curricula and Syllabi for I to IV Semesters

**M.E. Engineering Design (Full-Time)**

## Semester I

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L   T   P</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>ED5151</td>
<td>Advanced Mechanics of Materials</td>
<td>PCC</td>
<td>3   1   0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>ED5152</td>
<td>Advanced Mechanisms in Design</td>
<td>PCC</td>
<td>3   1   0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>ED5153</td>
<td>Computer Applications in Design</td>
<td>PCC</td>
<td>3   0   0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>ED5154</td>
<td>Vibration Analysis and Control</td>
<td>PCC</td>
<td>3   0   0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>RM5151</td>
<td>Research Methodology and IPR</td>
<td>PCC</td>
<td>2   0   0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>Program Elective - I</td>
<td></td>
<td>PEC</td>
<td>3   0   0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>Audit Course - I*</td>
<td></td>
<td>AC</td>
<td>2   0   0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td><strong>PRACTICAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>ED5111</td>
<td>Cad and Design for Manufacture and Assembly Laboratory</td>
<td>PCC</td>
<td>0   0   4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>9.</td>
<td>ED5112</td>
<td>Noise, Vibration and Harshness Laboratory</td>
<td>PCC</td>
<td>0   0   4</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

**TOTAL** 19 2 8 29 23

* Audit Course is optional.

## Semester II

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L   T   P</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>ED5251</td>
<td>Designing with Advanced Materials</td>
<td>PCC</td>
<td>3   0   0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>ED5252</td>
<td>Finite Element Methods in Mechanical Design</td>
<td>PCC</td>
<td>3   1   0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>ED5253</td>
<td>Integrated Product Design and Process Development</td>
<td>PCC</td>
<td>3   0   0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>Program Elective - II</td>
<td></td>
<td>PEC</td>
<td>3   0   0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>Program Elective - III</td>
<td></td>
<td>PEC</td>
<td>3   0   0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>Program Elective - IV</td>
<td></td>
<td>PEC</td>
<td>3   0   0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>Audit Course – II*</td>
<td></td>
<td>AC</td>
<td>2   0   0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td><strong>PRACTICAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>ED5261</td>
<td>Simulation and Analysis Laboratory</td>
<td>PCC</td>
<td>0   0   4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>9.</td>
<td>PD5461</td>
<td>Product Design Laboratory</td>
<td>PCC</td>
<td>0   0   4</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

**TOTAL** 20 1 8 29 23

* Audit Course is optional.
## SEMESTER III

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td>Program Elective-V</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>Program Elective-VI</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>Open Elective</td>
<td>OE</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### PRACTICAL

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td>ED5311</td>
<td>Technical Seminar</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>ED5312</td>
<td>Dissertation - I</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
</tbody>
</table>

**TOTAL**

<table>
<thead>
<tr>
<th>PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>theory</td>
<td>9</td>
<td>0</td>
<td>14</td>
<td>23</td>
<td>16</td>
</tr>
<tr>
<td>practical</td>
<td>0</td>
<td>0</td>
<td>24</td>
<td>24</td>
<td>12</td>
</tr>
</tbody>
</table>

TOTAL NO. OF CREDITS: 74

## SEMESTER IV

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>1</td>
<td>ED5411</td>
<td>Dissertation - II</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>24</td>
</tr>
</tbody>
</table>

**TOTAL**

<table>
<thead>
<tr>
<th>PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>practical</td>
<td>0</td>
<td>0</td>
<td>24</td>
<td>24</td>
<td>12</td>
</tr>
</tbody>
</table>

TOTAL NO. OF CREDITS: 74
### PROGRAM CORE COURSES (PCC)

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ED5111</td>
<td>CAD and Design for Manufacture and Assembly Laboratory</td>
<td>PCC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>ED5112</td>
<td>Noise, Vibration and Harshness Laboratory</td>
<td>PCC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>ED5151</td>
<td>Advanced Mechanics of Materials</td>
<td>PCC</td>
<td>3 1 0</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4.</td>
<td>ED5152</td>
<td>Advanced Mechanisms in Design</td>
<td>PCC</td>
<td>3 1 0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5.</td>
<td>ED5153</td>
<td>Computer Applications in Design</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>ED5154</td>
<td>Vibration Analysis and Control</td>
<td>PCC</td>
<td>4 0 0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>7.</td>
<td>ED5251</td>
<td>Designing with Advanced Materials</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>ED5252</td>
<td>Finite Element Methods in Mechanical Design</td>
<td>PCC</td>
<td>3 1 0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>9.</td>
<td>ED5253</td>
<td>Integrated Product Design and Process Development</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>ED5261</td>
<td>Simulation and Analysis Laboratory</td>
<td>PCC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>11.</td>
<td>PD5461</td>
<td>Product Design Laboratory</td>
<td>PCC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

### PROGRAM ELECTIVES COURSES

#### SEMESTER I, ELECTIVES - I

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ED5075</td>
<td>Design for Sustainability</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>ED5074</td>
<td>Composite Materials and Mechanics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>ED5077</td>
<td>Design of Hydraulic and Pneumatic Systems</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

#### SEMESTER II, ELECTIVES - II

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ED5001</td>
<td>Surface Engineering</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>ED5072</td>
<td>Advanced Machine Tool Design</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>PD5351</td>
<td>Product Lifecycle Management</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
### SEMESTER II, ELECTIVES - III

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ED5081</td>
<td>Optimization Techniques in Design</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>ED5082</td>
<td>Quality Concepts in Design</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>ED5080</td>
<td>Mechanical Measurements and Analysis</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

### SEMESTER II, ELECTIVES - IV

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ED5084</td>
<td>Vehicle Dynamics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>ED5078</td>
<td>Engineering Fracture Mechanics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>ED5073</td>
<td>Bearing Design and Rotor Dynamics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CI5151</td>
<td>Solid Freeform Manufacturing</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

### SEMESTER III, ELECTIVES - V

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ED5071</td>
<td>Advanced Finite Element Analysis</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>ED5076</td>
<td>Design of Hybrid and Electric Vehicles</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>ED5083</td>
<td>Tribology in Design</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

### SEMESTER III, ELECTIVES - VI

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ED5079</td>
<td>Material Handling Systems and Design</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>PD5151</td>
<td>Creativity and Innovation</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>IC5251</td>
<td>Computational Fluid Dynamics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>SL. NO.</td>
<td>COURSE CODE</td>
<td>COURSE TITLE</td>
<td>PERIODS PER WEEK</td>
<td>CREDITS</td>
<td>SEMESTER</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td>----------------------------------------</td>
<td>------------------</td>
<td>---------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PERIODS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>RM5151</td>
<td>Research Methodology and IPR</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

**OPEN ELECTIVE COURSES [OEC]**
(Out of 6 Courses one Course must be selected)

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>1.</td>
<td>OE5091</td>
<td>Business Data Analytics</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>OE5092</td>
<td>Industrial Safety</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>OE5093</td>
<td>Operations Research</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>OE5094</td>
<td>Cost Management of Engineering Projects</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>OE5095</td>
<td>Composite Materials</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>OE5096</td>
<td>Waste to Energy</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

**AUDIT COURSES (AC)**
Registration for any of these courses is optional to students

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>PERIODS</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
</tr>
<tr>
<td>1.</td>
<td>AX5091</td>
<td>English for Research Paper Writing</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>AX5092</td>
<td>Disaster Management</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>AX5093</td>
<td>Sanskrit for Technical Knowledge</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>AX5094</td>
<td>Value Education</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>AX5095</td>
<td>Constitution of India</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>AX5096</td>
<td>Pedagogy Studies</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>7.</td>
<td>AX5097</td>
<td>Stress Management by Yoga</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>8.</td>
<td>AX5098</td>
<td>Personality Development Through Life Enlightenment Skills</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>9.</td>
<td>AX5099</td>
<td>Unnat Bharat Abhiyan</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

**EMPLOYABILITY ENHANCEMENT COURSES (EEC)**

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>1.</td>
<td>ED5311</td>
<td>Technical Seminar</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>ED5312</td>
<td>Dissertation-I</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>3.</td>
<td>ED5411</td>
<td>Dissertation-II</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>24</td>
</tr>
</tbody>
</table>
OBJECTIVES

1. To learn the concepts of theory of elasticity in three-dimensional stress system.
2. To study the shear centre of various cross-sections and deflections in beams subjected to unsymmetrical bending.
3. To learn the stresses in flat plates and curved members.
4. To study torsional stress of non-circular sections.
5. To learn the stresses in rotating members, contact stresses in point and line contact applications.

UNIT-I  ELASTICITY  9+3

UNIT-II  SHEAR CENTRE AND UNSYMMETRICAL BENDING  9+3
Location of shear centre for various thin sections - shear flows. Stresses and Deflections in beams subjected to unsymmetrical loading-kern of a section.

UNIT-III  STRESSES IN FLAT PLATES AND CURVED MEMBERS  9+3
Circumference and radial stresses – deflections - curved beam with restrained ends - closed ring subjected to concentrated load and uniform load - chain links and crane hooks. Solution of rectangular plates – pure bending of plates – deflection – uniformly distributed load – various end conditions

UNIT-IV  TORSION OF NON-CIRCULAR SECTIONS  9+3
Torsion of rectangular cross section - St.Venants theory - elastic membrane analogy - Prandtl's stress function - torsional stress in hollow thin walled tubes.

UNIT-V  STRESSES IN ROTATING MEMBERS AND CONTACT STRESSES  9+3
Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness allowable speeds. Methods of computing contact stress-deflection of bodies in point and line contact applications.

TOTAL = 60 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
1. apply the concepts of theory of elasticity in three-dimensional stress system.
2. determine the shear centre of various cross-sections and deflections in beams subjected to unsymmetrical bending.
3. evaluate the stresses in flat plates and curved members.
4. calculate torsional stress of non-circular sections.
5. determine the stresses in rotating members, contact stresses in point and line contact applications.
REFERENCES:

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>2</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>3</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>4</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>5</td>
<td>0.9</td>
<td>0.6</td>
</tr>
</tbody>
</table>

0.3- Low 0.6- Medium 0.9- High

ED5152 ADVANCED MECHANISMS IN DESIGN 3 1 0 4

OBJECTIVES
1. To learn the concepts of gross motion capability and develop multi loop kinematic chains and equivalent mechanisms
2. To study complex mechanisms to determine velocity and acceleration of output links.
3. To learn to locate inflection points and to draw the inflection circle
4. To study the synthesis of planar mechanisms
5. To learn to design of six bar coupler driven mechanisms and cam mechanisms

UNIT-I INTRODUCTION 9+3

UNIT-II KINEMATIC ANALYSIS 9+3

UNIT-III PATH CURVATURE THEORY, COUPLER CURVE 9+3
Fixed and moving centrodes, inflection points and inflection circle. Euler Savary equation, graphical constructions – cubic of stationary curvature. Four bar coupler curve-cusp -crunode -coupler driven six-bar mechanisms-straight line mechanisms
UNIT-IV  SYNTHESIS OF FOUR BAR MECHANISMS  
Type synthesis – Number synthesis – Associated Linkage Concept. Dimensional synthesis – function generation, path generation, motion generation. Graphical methods-Pole technique inversion technique-point position reduction-two, three and four position synthesis of four- bar mechanisms. Analytical methods- Freudenstein’s Equation-Bloch’s Synthesis.

UNIT-V  SYNTHESIS OF COUPLER CURVE BASED MECHANISMS & CAM MECHANISMS  

TOTAL = 60 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
1. Apply concepts of gross motion capability and develop multi loop kinematic chains and equivalent mechanisms
2. Determine velocity and acceleration of complex mechanisms
3. Evaluate inflection points and draw the inflection circle
4. Synthesise planar mechanisms
5. Design of six bar coupler driven mechanisms and cam mechanisms

REFERENCES:

0.3- Low     0.6- Medium     0.9- High

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.9</td>
<td>0.6</td>
<td>0.6</td>
<td>0.9</td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.9</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>2</td>
<td>0.9</td>
<td>0.6</td>
<td>0.6</td>
<td>0.9</td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.9</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>3</td>
<td>0.9</td>
<td>0.6</td>
<td>0.6</td>
<td>0.9</td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.9</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>4</td>
<td>0.9</td>
<td>0.6</td>
<td>0.6</td>
<td>0.9</td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.9</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>5</td>
<td>0.9</td>
<td>0.6</td>
<td>0.6</td>
<td>0.9</td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.9</td>
<td>0.3</td>
<td>0.6</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:
1. To understand fundamental concepts of computer graphics and its tools in a generic framework.
2. To impart the parametric fundamentals to create and manipulate geometric models using curves, surfaces and solids.
3. To impart the parametric fundamentals to create and manipulate geometric models using NURBS and solids.
4. To provide clear understanding of CAD systems for 3D modeling and viewing.
5. To create strong skills of assembly modeling and prepare the student to be an effective user of standards in CAD system.

UNIT – I  INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS
Geometric Transformations: Coordinate Transformations, Windowing and Clipping, 2D Geometric transformations-Translation, Scaling, Shearing, Rotation and Reflection, Composite transformation, 3D transformations.

UNIT – II  CURVES AND SURFACES MODELLING
Introduction to curves - Analytical curves: line, circle and conics – synthetic curves: Hermite cubic spline- Bezier curve and B-Spline curve – curve manipulations.

UNIT – III  NURBS AND SOLID MODELING

UNIT – IV  VISUAL REALISM
Animation - Conventional, Computer animation, Engineering animation - types and techniques.

UNIT – V  ASSEMBLY OF PARTS AND PRODUCT LIFE CYCLE MANAGEMENT

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Solve 2D and 3D transformations for the basic entities like line and circle.
2. Formulate the basic mathematics fundamental to CAD system.
3. Use the different geometric modeling techniques like feature based modeling, surface modeling and solid modeling.
4. Create geometric models through animation and transform them into real world systems
REFERENCES:

0.3- Low 0.6- Medium 0.9- High

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.6</td>
<td>0.9</td>
</tr>
<tr>
<td>2</td>
<td>0.6</td>
<td>0.9</td>
</tr>
<tr>
<td>3</td>
<td>0.6</td>
<td>0.9</td>
</tr>
<tr>
<td>4</td>
<td>0.6</td>
<td>0.9</td>
</tr>
<tr>
<td>5</td>
<td>0.6</td>
<td>0.9</td>
</tr>
</tbody>
</table>

ED5154 VIBRATION ANALYSIS AND CONTROL L T P C 3 0 0 3

OBJECTIVES
- To appreciate the basic concepts of vibration in damped and undamped systems
- To calculate the natural frequencies and mode shapes of the two degree freedom systems
- To determine the natural frequencies and mode shapes of the multi degree freedom and continuous systems
- To learn the fundamentals of control techniques of vibration and noise levels
- To use the instruments for the measuring and analyzing the vibration levels in a body

UNIT-I FUNDAMENTALS OF VIBRATION 9+3

UNIT-II TWO DEGREE FREEDOM SYSTEM 9+3
Introduction-Free Vibration Of Undamped And Damped - Forced Vibration With Harmonic Excitation System –Coordinate Couplings And Principal Coordinates.

UNIT-III MULTI-DEGREE FREEDOM SYSTEM AND CONTINUOUS SYSTEM 9+3
Multi Degree Freedom System –Influence Coefficients and stiffness coefficients- Flexibility Matrix and Stiffness Matrix – Eigen Values and Eigen Vectors-Matrix Iteration Method –Approximate Methods: Dunkerley, Rayleigh’s, and Holzer Method -Geared Systems-Eigen Values & Eigenvectors for large system of equations using sub space, Lanczos method - Continuous System: Vibration of String, Shafts and Beams
UNIT-IV VIBRATION AND NOISE CONTROL 9+3

UNIT-V EXPERIMENTAL METHODS IN VIBRATION ANALYSIS 9+3
TOTAL = 60 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
1. apply the basic concepts of vibration in damped and undamped systems
2. determine the natural frequencies and mode shapes of the two degree freedom systems.
3. calculate the natural frequencies and mode shapes of the multi degree freedom and continuous systems
4. control the vibration and noise levels in a body
5. measure and analyze the vibration levels in a body

REFERENCES:

0.3- Low 0.6- Medium 0.9- High

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>2</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>3</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>4</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>5</td>
<td>0.6</td>
<td>0.9</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:
To impart knowledge and skills required for research and IPR:
- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I  RESEARCH PROBLEM FORMULATION  6
Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT II  LITERATURE REVIEW  6
Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III  TECHNICALWRITING /PRESENTATION  6
Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV  INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR)  6

UNIT V  INTELLECTUAL PROPERTY RIGHTS (IPR)  6

TOTAL: 30 PERIODS

COURSE OUTCOMES:
1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

<table>
<thead>
<tr>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:
ED5111  CAD AND DESIGN FOR MANUFACTURE AND ASSEMBLY LABORATORY

0 0 4 2

- CAD Introduction.
- Sketcher
- **Solid modeling** – Extrude, Revolve, Sweep, etc and Variational sweep, Loft, etc
- **Surface modeling** – Extrude, Sweep, Trim, etc and Mesh of curves, Free form etc
- **Feature manipulation** – Copy, Edit, Pattern, Suppress, History operations etc.
- **Assembly** - Constraints, Exploded Views, Interference check
- **Drafting** - Layouts, Standard & Sectional Views, Detailing & Plotting.

Exercises in modeling and drafting of mechanical components - assembly using parametric and feature based packages. 2D TO 3D CONVERSION.

**DESIGN FOR MANUFACTURE AND ASSEMBLY LABORATORY**


The students will be given training on the use and application of the following

1. DFMA software

**OUTCOMES:**
On Completion of the course the student will be able to
1. Use the modern engineering tools necessary for engineering practice
2. Draw 2D part drawings, sectional views and assembly drawings as per standards.
3. Create 3D Model on any CAD software.
4. Convert 3D solid models into 2D drawing and prepare different views, sections and dimensioning of part models.
5. familiarize with DFMA package which is necessary for cost estimation and evaluating the product design

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.3 0.6 0.3</td>
<td>0.6 0.6 0.3</td>
</tr>
<tr>
<td>2</td>
<td>0.3 0.6 0.3</td>
<td>0.6 0.6 0.3</td>
</tr>
<tr>
<td>3</td>
<td>0.3 0.6 0.3</td>
<td>0.6 0.6 0.3</td>
</tr>
<tr>
<td>4</td>
<td>0.3 0.6 0.3</td>
<td>0.6 0.6 0.3</td>
</tr>
<tr>
<td>5</td>
<td>0.3 0.6 0.3</td>
<td>0.6 0.6 0.3</td>
</tr>
</tbody>
</table>
ED5112 NOISE, VIBRATION AND HARSNESS LABORATORY

L T P C
0 0 4 2

OBJECTIVE:
To impart knowledge on the fundamentals of vibration and noise, practical use of instruments for measurement of vibration and noise

LIST OF EXPERIMENTS:

1) Determination of stiffness and natural frequency of undamped spring-mass systems arranged in series, parallel and series-parallel fashions
2) Determination of natural frequency a single rotor shaft system
3) Determination of critical speed of shaft
4) Dynamic balancing of a rotor
5) Determination of natural frequency and mode shapes of specimens supported at its ends
6) Determination of damping coefficient of specimens supported at its ends
7) Forced vibration of a component vibrated through sine profile – Determination of natural frequency and durability
8) Forced vibration of a component vibrated through random profile – Determination of natural frequency and durability
9) Measurement of noise level using a sound level meter

OUTCOMES:
On Completion of the course the student will be able to
1. determine the natural frequency, damping coefficient, mode shapes and critical speed of various systems
2. apply the concepts of dynamic balancing technique to balance various components.
3. vibrate components using shakers and test for their durability.
4. determine the noise levels in various components.

TOTAL: 60 PERIODS

0.3- Low 0.6- Medium 0.9- High

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.9</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.9</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.9</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.9</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. analyzing the different strengthening and failure mechanism of the metals
2. applying the effects of metallurgical parameters in the materials design
3. analyzing the relationship between the selection of materials and processing
4. developing the novel material through understanding the properties of the existing metallic materials
5. analyzing the different materials used in the engineering applications

UNIT-I BASIC CONCEPTS OF MATERIAL BEHAVIOR
Engineering Design process and the role of materials; materials classification and their properties, Strengthening mechanisms-grain size reduction, solid solution strengthening, strain hardening, grain boundary strengthening, precipitation, particle, fibre and dispersion strengthening, Effect of temperature, strain and strain rate on plastic behavior – Super plasticity – Failure of metals

UNIT-II BEHAVIOUR UNDER CYCLIC LOADS AND DESIGN APPROACHES
Stress intensity factor and fracture toughness – Fatigue-low and high cycle fatigue test, fracture mechanisms and Paris law.- Effect of surface and metallurgical parameters on fatigue – Safe life, Stress-life, strain-life and fail - safe design approaches- Fracture of nonmetallic Materials – Failure analysis, sources of failure, procedure of failure analysis

UNIT-III SELECTION OF MATERIALS
Selection of materials based on function, Objective, Constraints, free variables and service requirements – Relationship between materials selection and processing – Case studies in advanced materials selection with relevance to aero, auto, marine, machinery and nuclear applications

UNIT-IV MODERN METALLIC MATERIALS

UNIT-V NON METALLIC MATERIALS

TOTAL = 45 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
1. analyze the different strengthening and failure mechanism of the metals
2. apply the effects of metallurgical parameters in the materials design
3. analyze the relationship between the selection of materials and processing
4. develop the novel material through understanding the properties of the existing metallic materials
5. analyze the different materials used in the engineering applications
REFERENCES:
8. www.astm.org/labs/pages/131350.htm

<table>
<thead>
<tr>
<th>CO</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.9</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>2</td>
<td>0.9</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>3</td>
<td>0.9</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>4</td>
<td>0.9</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>5</td>
<td>0.9</td>
<td>0.3</td>
<td>0.6</td>
</tr>
</tbody>
</table>

ED5252  FINITE ELEMENT METHODS IN MECHANICAL DESIGN

OBJECTIVES
- To learn mathematical models for one dimensional problems and their numerical solutions
- To learn two dimensional scalar and vector variable problems to determine field variables
- To learn Isoparametric transformation and numerical integration for evaluation of element matrices
- To study various solution techniques to solve Eigen value problems
- To learn solution techniques to solve non-linear problems

UNIT-I  FINITE ELEMENT ANALYSIS OF ONE DIMENSIONAL PROBLEMS


UNIT-II  FINITE ELEMENT ANALYSIS OF TWO DIMENSIONAL PROBLEMS

UNIT-III  ISO-PARAMETRIC FORMULATION  9+3

UNIT-IV  EIGEN VALUE PROBLEMS  9+3
Dynamic Analysis – Equations of Motion – Consistent and lumped mass matrices – Free Vibration analysis – Natural frequencies of Longitudinal, Transverse and torsional vibration – Solution of Eigenvalue problems - Introduction to transient field problems

UNIT-V  NON-LINEAR ANALYSIS  9+3
Introduction to Non-linear problems - some solution techniques- computational procedure-material non-linearity-Plasticity and viscoplasticity, stress stiffening, contact interfaces- problems of gaps and contact - geometric non-linearity - modeling considerations - Free and Mapped meshing - Mesh quality- Error estimate

TOTAL = 60 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
1. Develop mathematical models for one dimensional problems and their numerical solutions
2. Determine field variables for two dimensional scalar and vector variable problems
3. Apply Isoparametric transformation and numerical integration for evaluation of element matrices
4. Apply various solution techniques to solve Eigen value problems
5. Formulate solution techniques to solve non-linear problems

REFERENCES:

0.3- Low 0.6- Medium 0.9- High

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>2</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>3</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>4</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>5</td>
<td>0.9</td>
<td>0.6</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:
1. To understand the principles of generic development process; product planning; customer need analysis for new product design and development.
2. To enhance the understanding of setting product specifications and generate, select, screen, and test concepts for new product design and development.
3. To apply the principles of product architecture and the importance of industrial design principles and DFM principles for new product development.
4. To expose the different Prototyping techniques, Design of Experiment principles to develop a robust design and importance to patent a developed new product.
5. Applying the concepts of economics principles; project management practices in development of new product.

UNIT – I INTRODUCTION TO PRODUCT DESIGN AND IDENTIFICATION OF CUSTOMER NEED
Need for IPPD - Strategic importance of Product development – Duration and Cost of Product Development – Challenges in Product Development - Product Development Processes and Organizations – Activities in Identifying Customer Needs

UNIT – II PRODUCT SPECIFICATIONS, CONCEPT GENERATION, SELECTION AND TESTING
Plan and establish Target and Final product specifications – Activities of Concept Generation - Task - Concept Selection methodology – Concept Screening and Scoring - Concept Testing Methodologies.

UNIT – III PRODUCT ARCHITECTURE, INDUSTRIAL DESIGN AND DESIGN FOR MANUFACTURE
Product Architecture – Implications and establishing the architecture – Delayed Differentiation – Platform Planning - Need and impact of industrial design - Industrial design process - management of the industrial design process - assessing the quality of industrial design – DFM Definition - Estimation of Manufacturing cost- Reducing the component costs, costs of supporting function and assembly costs – Impact of DFM decision on other factors.

UNIT – IV PROTOTYPING, ROBUST DESIGN AND INTELLECTUAL PROPERTY
Prototype basics - Principles of prototyping - Planning for prototypes - Robust design – Seven step process of Robust Design through Design of Experiments- Need and Importance of Intellectual Property – Seven step process of preparing a patent document.

UNIT – V PRODUCT DEVELOPMENT ECONOMICS AND MANAGING PROJECTS
Economic Analysis – Elements of Economic Analysis - Understanding and representing tasks- baseline project planning - accelerating the project - project execution – postmortem project evaluation.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of this course, the students will be able to:

1. Apply the principles of generic development process; product planning; customer need analysis for new product design and development.
2. Set product specifications and generate, select, screen, test concepts for new product design and development.
3. Apply the principles of product architecture, industrial design and design for manufacturing principles in new product development.
4. Apply the adopt Prototyping techniques and Design of Experiment principles to develop a robust design and document a new product for patent.
5. Apply of the concepts of economics principles; project management practices in accelerating the new product development activity.

REFERENCES:

ED5261 SIMULATION AND ANALYSIS LABORATORY

OBJECTIVES:
• To give exposure to software tools needed to analyze engineering problems.

LIST OF EXPERIMENTS
1. Force and Stress analysis using link elements in Trusses.
2. Stress and deflection analysis in beams with different support conditions.
5. Thermal stress and heat transfer analysis of plates.
7. Vibration analysis of spring-mass systems.
8. Modal analysis of Beams.
9. Harmonic, transient and spectrum analysis of simple systems.
10. Analysis of machine elements under dynamic loads.
11. Analysis of non-linear systems.

TOTAL : 60 PERIODS
LIST OF EQUIPMENTS / SOFTWARE:
Finite Element Analysis packages

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Solve engineering problems numerically using Computer Aided Finite Element Analysis packages

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3- Low</td>
<td>0.6- Medium</td>
<td>0.9- High</td>
</tr>
<tr>
<td>1</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>2</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>3</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>4</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>5</td>
<td>0.9</td>
<td>0.9</td>
</tr>
</tbody>
</table>

PD5461 PRODUCT DESIGN LABORATORY

OBJECTIVES:
- To give exposure to develop digital and physical prototype models using RP machine / clay models of a new product / existing product.

The students in a group have to develop digital and physical prototype models using RP machine / clay models of a new product/ existing product with enhanced feature involving the following areas:
  - Automotive components
  - Tool and die components
  - Press tool components
  - Consumer product
  - Injection moulded products.

The fabricated models may be in the form of RP models, clay models, sheet metal models or cardboard models etc…

The design and development of the product will be reviewed in two stages for awarding internal marks. The end semester examination mark will be based on the demonstration of the new product developed and oral examination on the same by internal examiners.

TOTAL : 60 PERIODS

COURSE OUTCOMES:
1. appreciate the use of physical prototype models for evaluating product concept
2. apply theoretical knowledge to design and development of physical products using clay, wood, sheet metal and RP techniques

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3- Low</td>
<td>0.6- Medium</td>
<td>0.9- High</td>
</tr>
<tr>
<td>1</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>2</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>3</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>4</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>5</td>
<td>0.9</td>
<td>0.6</td>
</tr>
</tbody>
</table>
ED5311  TECHNICAL SEMINAR  L T P C  0 0 2 1

OBJECTIVE:
- To work on a specific technical topic in Engineering design related topics in order to acquire the skills of oral presentation
- To acquire technical writing abilities for seminars and conferences

The students will work for two hours per week guided by a group of staff members. They will be asked to talk on any topic of their choice related to Engineering design topics and to engage in dialogue with the audience. A brief copy of their talk also should be submitted. Similarly, the students will have to present a seminar of not less than fifteen minutes and not more than thirty minutes on the technical topic. They will also answer the queries on the topic. The students as audience also should interact. Evaluation will be based on the technical presentation and the report and also on the interaction during the seminar.

TOTAL: 30 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
Students comprehend concepts and methods adequate to understand inductive and deductive reasoning, and increase their general problem solving skills. Students develop communicative skills (e.g. speaking, listening, reading, and/or writing).

0.3- Low 0.6- Medium 0.9- High

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

ED5075  DESIGN FOR SUSTAINABILITY  L T P C  3 0 0 3

COURSE OBJECTIVES
The main learning objective of this course is to prepare the students for:
1. Selecting the relevant process; applying the general design principles for manufacturability; GD&T.
2. Applying the design considerations while designing the cast and welded components.
3. Applying the design considerations while designing the formed and machined components.
4. Apply design considerations for assembled systems.
5. Apply design considerations for environmental issues.

UNIT-I  INTRODUCTION  9
Introduction - Economics of process selection - General design principles for manufacturability; Geometric Dimensioning & Tolerance (GD&T) – Form tolerancing: straightness, flatness, circularity, cylindricity – Profile tolerancing: profile of a line, and surface – Orientation tolerancing: angularity, perpendicularity, parallelism – Location tolerancing: position, concentricity, symmetry – run out tolerancing: circular and total – Supplementary symbols

UNIT-II CAST & WELDED COMPONENTS DESIGN  9
UNIT-III  FORMED & MACHINED COMPONENTS DESIGN

Design considerations for: Metal extruded parts – Impact/Cold extruded parts – Stamped parts – Forged parts. Design considerations for: Turned parts – Drilled parts – Milled, planned, shaped and slotted parts– Ground parts

UNIT-IV  DESIGN FOR ASSEMBLY


UNIT-V  DESIGN FOR ENVIRONMENT


TOTAL = 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

1. Select relevant process; apply the general design principles for manufacturability; GD&T
2. Apply design considerations while designing the cast and welded components
3. Apply design considerations while designing the formed and machined components
4. Apply design considerations for assembled systems.
5. Apply design considerations for environmental issues

REFERENCES:


0.3- Low 0.6- Medium 0.9- High

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>PSO</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.6</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.6</td>
<td>0.3</td>
<td>0.9</td>
<td>0.6</td>
<td>0.9</td>
<td>0.9</td>
<td>0.6</td>
<td>0.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.6</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.6</td>
<td>0.3</td>
<td>0.9</td>
<td>0.6</td>
<td>0.9</td>
<td>0.9</td>
<td>0.6</td>
<td>0.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.6</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.6</td>
<td>0.3</td>
<td>0.9</td>
<td>0.6</td>
<td>0.9</td>
<td>0.9</td>
<td>0.6</td>
<td>0.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.6</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.6</td>
<td>0.3</td>
<td>0.9</td>
<td>0.6</td>
<td>0.9</td>
<td>0.9</td>
<td>0.6</td>
<td>0.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0.6</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.6</td>
<td>0.3</td>
<td>0.9</td>
<td>0.6</td>
<td>0.9</td>
<td>0.9</td>
<td>0.6</td>
<td>0.9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:
1. Study of different composite materials and finding its mechanical strength
2. Fabrication of FRP and other composites by different manufacturing methods
3. Stress analysis of fiber reinforced Laminates for different combinations of plies with different orientations of the fiber.
4. Calculation of stresses in the lamina of the laminate using different failure theories
5. Calculation of residual stresses in different types of laminates under thermo-mechanical load using the Classical Laminate Theory.

UNIT-I INTRODUCTION TO COMPOSITE MATERIALS

UNIT-II MANUFACTURING OF COMPOSITES
Manufacturing of Polymer Matrix Composites (PMCs)-handlay-up, spray technique, filament winding, Pultrusion, Resin Transfer Moulding (RTM)-, bag moulding, injection moulding, Sandwich Mould Composites (SMC) - Manufacturing of Metal Matrix Composites (MMCs) - Solid state, liquid state,vapour state processing, Manufacturing of Ceramic Matrix Composites (CMCs) – hot pressing-reaction bonding process-infiltration technique, direct oxidation- interfaces

UNIT-III LAMINA CONSTITUTIVE EQUATIONS

UNIT-IV LAMINA STRENGTH ANALYSIS AND ANALYSIS OF LAMINATED FLAT PLATES

UNIT-V THERMO-STRUCTURAL ANALYSIS
Case studies: Implementation of CLT for evaluating residual stresses in the components made with different isotropic layers such as electronic packages etc.

TOTAL = 45 PERIODS
COURSE OUTCOMES:
On Completion of the course the student will be able to
1. Calculate for mechanical strength of the composite material
2. fabricate the FRP and other composites by different manufacturing methods
3. analyze fiber reinforced Laminates for different combinations of plies with different orientations of the fiber.
4. Evaluate the stresses in the lamina of the laminate using different failure theories
5. analyze thermo-mechanical behavior and evaluate residual stresses in different types of laminates using the Classical Laminate Theory.

REFERENCES:

COURSE OBJECTIVES:
1. To introduce the different components of hydraulic systems and its design and selection procedures.
2. To formulate a thorough understanding on the need and use of various control and regulating elements in hydraulic systems.
3. To enable them to independently design hydraulic circuits for industrial applications
4. To expose them to the different components of pneumatic systems and enable them to design simple pneumatic systems.
5. To make them understand the need to integrate electronics and develop low cost systems and provide solution to simple industrial applications

UNIT – I OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS
Hydraulic Power Generators – Selection and specification of pumps, pump characteristics. Linear and Rotary Actuators – selection, specification and characteristics, Hydrostatic drives, types, selection

ED5077 DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS

| CO | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 1  | 2  | 3  |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 0.3-Low | 0.6 | 0.6 | 0.9 | 0.9 | 0.6 | 0.6 | | 0.6 | 0.3 | 0.3 |
| 0.6-Medium | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | | 0.6 | 0.3 | 0.3 |
| 0.9-High | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 | | 0.6 | 0.3 | 0.3 |

REFERENCES:
UNIT – II  CONTROL AND REGULATION ELEMENTS  9
Pressure - direction and flow control valves, relief valves, non-return and safety valves - actuation systems, Proportional Electro hydraulic servo valves

UNIT – III  HYDRAULIC CIRCUITS  9
Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits - industrial circuits - press circuits - hydraulic milling machine - grinding, planning, copying, - forklift, earth mover circuits design methodology- design and selection of components - safety and emergency mandrels – Cascade method

UNIT – IV  PNEUMATIC SYSTEMS AND CIRCUITS  9
Pneumatic fundamentals - control elements, position and pressure sensing, Pneumatic equipments- selection of components - design calculations - logic circuits - switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods - step counter method - compound circuit design - combination circuit design- Karnaugh - Veitch map

UNIT – V  ELECTROMAGNETIC & ELECTRONIC CONTROL OF HYDRAULICS & PNEUMATIC CIRCUIT  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Design and select appropriate pumps in industries based on need.
2. Select correct sizing and rating of control elements in hydraulics.
3. Design basic circuits (hydraulic) for industrial applications.
4. Design basic pneumatic circuits for industrial applications.
5. Identify and provide solution for troubleshooting and design low cost automation for industrial application.

REFERENCES:

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3- Low</td>
<td>0.6- Medium</td>
<td>0.9- High</td>
</tr>
<tr>
<td>1</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>2</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>3</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>4</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>5</td>
<td>0.9</td>
<td>0.6</td>
</tr>
</tbody>
</table>
ED5001
SURFACE ENGINEERING

COURSE OBJECTIVES:
1. To study the basics of surface features and different types of friction in metals and non-metals.
2. To analyze the different types of wear mechanism and international standard used in friction and wear measurement
3. To study the different types of corrosion and its preventive measures.
4. To study the different types of surface treatments and surface modification techniques.
5. To analyze the different types of materials used in the friction and wear applications

UNIT-I       FRICITION               7
Topography of Surfaces – Surface features – Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction – Rolling Friction – Friction properties of metallic and nonmetallic materials – Friction in extreme conditions – Thermal considerations in sliding contact

UNIT-II      WEAR                   6
Introduction – Abrasive wear, Erosive, Cavitation, Adhesion, Fatigue wear and Fretting Wear
Laws of wear – Theoretical wear models – Wear of metals and non metals – International standards in friction and wear measurement

UNIT-III     CORROSION              10

UNIT-IV      SURFACE TREATMENTS    12

UNIT-V       ENGINEERING MATERIALS 10

TOTAL = 45 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
1. Understand the basics of surface features, laws of friction, and different types of friction
2. Develop the knowledge of various wear mechanism and its measurement
3. Understand the types of corrosion and its preventive measures
4. Familiarize the types of surface properties and various surface modification techniques
5. Ability to understand the different types of materials used in the friction and wear applications
REFERENCES:

<table>
<thead>
<tr>
<th>CO</th>
<th>0.3- Low</th>
<th>0.6- Medium</th>
<th>0.9- High</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>2</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>3</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>4</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>5</td>
<td>0.6</td>
<td>0.3</td>
<td>0.3</td>
</tr>
</tbody>
</table>

ED5072 ADVANCED MACHINE TOOL DESIGN

OBJECTIVES
The main learning objective of this course is to prepare the students for:
1. Selecting the different machine tool mechanisms.
2. Designing the Multi speed Gear Box and feed drives.
3. Designing the machine tool structures.
4. Designing the guideways and power screws.
5. Designing the spindles and bearings.

UNIT-I INTRODUCTION TO MACHINE TOOL DESIGN

UNIT-II REGULATION OF SPEEDS AND FEEDS
Aim of Speed and Feed Regulation, Stepped Regulation of Speeds, Multiple Speed Motors, Ray Diagrams and Design Considerations, Design of Speed Gear Boxes, Feed Drives, Feed Box Design

UNIT-III DESIGN OF MACHINE TOOL STRUCTURES

UNIT-IV DESIGN OF GUIDEWAYS AND POWER SCREWS
Functions and Types of Guideways, Design of Guideways, Design of Aerostatic Slide ways, Design of Anti-Friction Guideways, Combination Guideways, Design of Power Screws
OUTCOMES:
On completion of the course the student will be able to
1. Select the different machine tool mechanisms.
2. Design the Multi speed Gear Box and feed drives.
3. Design the machine tool structures.
4. Design the guideways and power screws.
5. Design the spindles and bearings.

REFERENCES:
1. N.K. Mehta, Machine Tool Design and Numerical Control, TMH, New Delhi, 2010

PD5351

COURSE OBJECTIVES
1. To study about the history, concepts and terminology in PLM
2. To understand the functions and features of PLM/PDM
3. To understand different modules offered in commercial PLM/PDM tools
4. To demonstrate PLM/PDM approaches for industrial applications
5. To use PLM/PDM with legacy data bases, CAx & ERP systems

UNIT-I
HISTORY, CONCEPTS AND TERMINOLOGY OF PLM
Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDM), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications

UNIT-II
PLM/PDM FUNCTIONS AND FEATURES
UNIT-III DETAILS OF MODULES IN A PDM/PLM SOFTWARE
Case studies based on top few commercial PLM/PDM tools – Teamcenter, Windchill, ENOVIA, Aras PLM, SAP PLM, Arena, Oracle Agile PLM and Autodesk Vault.

UNIT-IV ROLE OF PLM IN INDUSTRIES
Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for--business, organisation, users, product or service, process performance

UNIT-V BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE
PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP

OUTCOMES:
On Completion of the course the student will be able to
1. Summarize the history, concepts and terminology of PLM
2. Use the functions and features of PLM/PDM
3. Use different modules offered in commercial PLM/PDM tools.
4. Implement PLM/PDM approaches for industrial applications.
5. Integrate PLM/PDM with legacy data bases, CAx& ERP systems

REFERENCES:

0.3- Low 0.6- Medium 0.9- High

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>2</td>
<td>0.6</td>
<td>0.3</td>
</tr>
<tr>
<td>3</td>
<td>0.6</td>
<td>0.3</td>
</tr>
<tr>
<td>4</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>5</td>
<td>0.3</td>
<td>0.3</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:
1. To understand the basic concepts of unconstrained optimization techniques.
2. To understand the basic concepts of constrained optimization techniques.
3. To provide the mathematical foundation of artificial neural networks and swarm intelligence for design problems.
4. To implement optimization approaches and to select appropriate solution for design application.
5. To demonstrate selected optimization algorithms commonly used in static and dynamic applications.

UNIT – I UNCONSTRAINED OPTIMIZATION TECHNIQUES
Introduction to optimum design - General principles of optimization – Problem formulation & their classifications - Single variable and multivariable optimization, Techniques of unconstrained minimization – Golden section, Random, pattern and gradient search methods – Interpolation methods.

UNIT – II CONSTRAINED OPTIMIZATION TECHNIQUES
Optimization with equality and inequality constraints - Direct methods – Indirect methods using penalty functions, Lagrange multipliers - Geometric programming.

UNIT – III ARTIFICIAL NEURAL NETWORKS AND SWARM INTELLIGENCE
Introduction – Activation functions, types of activation functions, neural network architectures, Single layer feed forward network, multilayer feed forward network, Neural network applications. Swarm intelligence - Various animal behaviors, Ant Colony optimization, Particle Swarm optimization.

UNIT – IV ADVANCED OPTIMIZATION TECHNIQUES
Multi stage optimization – dynamic programming; stochastic programming; Multi objective optimization, Genetic algorithms and Simulated Annealing technique.

UNIT – V STATIC AND DYNAMIC APPLICATIONS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Formulate unconstrained optimization techniques in engineering design application.
2. Formulate constrained optimization techniques for various application.
3. Implement neural network technique to real world design problems.
4. Apply genetic algorithms to combinatorial optimization problems.
5. Evaluate solutions by various optimization approaches for a design problem.
REFERENCES:

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>2</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>3</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>4</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>5</td>
<td>0.9</td>
<td>0.6</td>
</tr>
</tbody>
</table>

ED5082 QUALITY CONCEPTS IN DESIGN

COURSE OBJECTIVES:
1. To impart knowledge on various concepts in engineering design, material selection and manufacturing methods.
2. To learn the principles of implementing quality in a product or services using different tools
3. To enhance the quality of product by use of failure mode effect analysis and implement methods to uphold the status of six sigma
4. To develop a robust product or service using various strategies of design of experiments
5. To maintain the quality of the product by use of statistical tools and enforce methods to improve the reliability of a product

UNIT – I DESIGN FUNDAMENTALS, METHODS AND MATERIAL SELECTION

UNIT – II DESIGN FOR QUALITY
Quality Function Deployment -House of Quality-Objectives and functions-Targets-Stakeholders-Measures and Matrices-Design of Experiments –design process-Identification of control factors, noise factors, and performance metrics - developing the experimental plan- experimental design – testing noise factors- Running the experiments –Conducting the analysis-Selecting and conforming factor-Set points-reflecting and repeating.

UNIT – III FAILURE MODE EFFECTS ANALYSIS AND DESIGN FOR SIX SIGMA
Basic methods: Refining geometry and layout, general process of product embodiment - Embodiment checklist- Advanced methods: systems modeling, mechanical embodiment principles-FMEA method- linking fault states to systems modeling - Basis of SIX SIGMA –
Project selection for SIX SIGMA- SIX SIGMA problem solving- SIX SIGMA in service and small organizations - SIX SIGMA and lean production – Lean SIX SIGMA and services.

UNIT – IV DESIGN OF EXPERIMENTS
Importance of Experiments, Experimental Strategies, Basic principles of Design, Terminology, ANOVA, Steps in Experimentation, Sample size, Single Factor experiments – Completely Randomized design, Randomized Block design, Statistical Analysis, Multifactor experiments - Two and three factor full Factorial experiments, 2K factorial Experiments, Confounding and Blocking designs, Fractional factorial design, Taguchi’s approach - Steps in experimentation, Design using Orthogonal Arrays, Data Analysis, Robust Design- Control and Noise factors, S/N ratios

UNIT – V STATISTICAL CONSIDERATION AND RELIABILITY

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. apply fundamentals of design process and material selection for developing a quality product
2. apply the quality concepts to develop a robust product
3. perform Failure Mode Effect Analysis on a product and use six sigma principles to enhance its quality
4. apply different experimental design methods in product development
5. implement various statistical tools to improve its quality and reliability

REFERENCES:

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>PSO</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.6</td>
<td>0.3</td>
<td></td>
<td></td>
<td>0.3</td>
<td>0.3</td>
<td>0.6</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.6</td>
<td>0.3</td>
<td></td>
<td></td>
<td>0.3</td>
<td>0.3</td>
<td>0.6</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.6</td>
<td>0.3</td>
<td></td>
<td></td>
<td>0.3</td>
<td>0.3</td>
<td>0.6</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.6</td>
<td>0.3</td>
<td></td>
<td></td>
<td>0.3</td>
<td>0.3</td>
<td>0.6</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.6</td>
<td>0.9</td>
<td>0.3</td>
<td></td>
<td></td>
<td>0.3</td>
<td>0.3</td>
<td>0.6</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

0.3- Low
0.6- Medium
0.9- High
COURSE OBJECTIVES:
1. The student will understand the principle of force and strain measurement.
2. The student will understand the vibration measurement and their applications.
3. To impart knowledge on the principle behind acoustics and wind flow measurements.
4. To familiarize with the distress measurements
5. To realize the nondestructive testing principle and application

UNIT – I FORCES AND STRAIN MEASUREMENT

UNIT – II VIBRATION MEASUREMENTS

UNIT – III ACOUSTICS AND WIND FLOW MEASUREMENTS

UNIT – IV DISTRESS MEASUREMENTS

UNIT – V NON DESTRUCTIVE TESTING METHODS
Load testing on structures, buildings, bridges and towers – Rebound Hammer – acoustic emission – ultrasonic testing principles and application – Holography – use of laser for structural testing – Brittle coating

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Measure physical quantities such as forces and strains.
2. Apply different vibration measurements techniques.
3. Measure physical quantities such as pressure and flow.
4. Apply techniques involved in crack measurement.
5. Select the appropriate nondestructive testing methods for various engineering applications.

REFERENCES:
0.3- Low 0.6- Medium 0.9- High

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>2</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>3</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>4</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>5</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>6</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>7</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>8</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>9</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>10</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>11</td>
<td>0.3</td>
<td>0.6</td>
</tr>
<tr>
<td>12</td>
<td>0.3</td>
<td>0.6</td>
</tr>
</tbody>
</table>

ED5084 VEHICLE DYNAMICS L T P C

3 0 0 3

COURSE OBJECTIVES:
The main learning objective of this course is to prepare students for:

1. Apply and develop mathematical model of a system
2. Applying vehicular vibrations and response of vehicle
3. Applying a tire model based on required performance.
4. Applying the various vehicle performance, control methodologies to ensure stability and ride comfort.
5. Applying the principles vertical, longitudinal and lateral dynamics vehicle design.

UNIT-I BASIS OF VIBRATION 9

UNIT-II TYRES 9

UNIT-III VERTICAL DYNAMICS 9

UNIT-IV LONGITUDINAL DYNAMICS AND CONTROL 9

UNIT-V LATERAL DYNAMICS 9

TOTAL = 45 PERIODS
OUTCOMES:
On completion of the course the student will be able to
- Formulate and develop mathematical model of a system
- Apply vehicular vibrations and response of vehicle
- Create a tire model based on required performance
- Predict vehicle performance, control methodologies to ensure stability and ride comfort
- Apply vertical, longitudinal and lateral dynamics vehicle design

REFERENCES:

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>2</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>3</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>4</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>5</td>
<td>0.6</td>
<td>0.9</td>
</tr>
</tbody>
</table>

ED5078 ENGINEERING FRACTURE MECHANICS

OBJECTIVES:
1. Formulation of governing equations for elastic problems
2. Stresses calculations/displacements around the crack tip for different modes of fracture
3. Estimation of K1c/SIF/critical flaws/failure stresses for different crack geometries
4. Life assessment of the cracked components under different types of repeated/variable fatigue loads and design for its life extension.
5. Analysis of failed engineering components under different modes of fracture.

UNIT-I ELEMENTS OF SOLID MECHANICS

UNIT-II STRESS AND DISPLACEMENT AROUND THE CRACK TIP FOR DIFFERENT MODES OF FRACTURE
UNIT-III STATIONARY CRACK UNDER STATIC LOADING


Two dimensional elastic fields – Analytical solutions for small scale yielding near a crack front — plastic zone size –Specimen size calculations: K1c Testing for Fracture toughness of the Material.

UNIT-IV FATIGUE FAILURE AND ENVIRONMENTAL-ASSISTED FRACTURE

Introduction to fatigue failure-S-N Curve-Crack Initiation-Crack propagation- Effect of an Overload-Variable amplitude Fatigue load-Crack closure- Characteristics of fatigue crack-Paris Law- Fatigue Crack Growth Test to evaluate Paris constants- life calculations for a given load amplitude —effects of changing the load spectrum

Environmental-assisted Fracture-Micro mechanisms-factors influencing Environmental-assisted fracture-Environment-assisted Fatigue Failure affecting fatigue performance, fatigue loading, constant and variable amplitude loading.

UNIT-V APPLICATIONS OF FRACTURE MECHANICS

J-integral, Mixed-mode fracture, Crack arrest methodologies- Case studies: Analysis on failed components and design for the extension of its life

TOTAL (L: 45 )=45 PERIODS

OUTCOMES:

On Completion of the course the student will be able to
1. Formulate governing equation for elastic problems
2. Calculate stresses/displacements around the crack tip for different modes of fracture
3. Estimate K1c/SIF/critical flaws/failure stresses for different crack geometries
4. Assess the life of the cracked components under different types of repeated/variable fatigue loads and design for its life extension.
5. Analyze failed engineering components under different modes of fracture.

REFERENCES:


<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>2</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>3</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>4</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>5</td>
<td>0.6</td>
<td>0.6</td>
</tr>
</tbody>
</table>
OBJECTIVES:
The main learning objective of this course is to prepare students for:
- Apply and develop mathematical model of a system
- Applying the design and suggest bearings for specific applications
- Applying a fatigue life calculations for various types of bearings
- Apply and analyze bearing behaviour
- Study the dynamics of rotors mounted on Hydrodynamic Bearings

UNIT-I  CLASSIFICATION AND SELECTION OF BEARINGS  6
Selection criteria-Dry and Boundary Lubrication Bearings-Hydrodynamic and Hydrostatic bearings-Electro Magnetic bearings-Dry bearings-Rolling Element bearings- Bearings for Precision. Applications-Foil Bearings-Special bearings- Selection of plain Bearing materials – Metallic and Non metallic bearings-Materials for rolling bearings

UNIT-II  DESIGN OF FLUID FILM BEARINGS  10

UNIT-III  ROLLING CONTACTS SELECTION OF ROLLING BEARINGS  10
Contact Stresses in Rolling bearings- Centrifugal stresses-Elasto hydrodynamic lubrication- Fatigue life calculations- Bearing operating temperature- Lubrication- Selection of lubricants- Internal clearance – Shaft and housing fit- Mounting arrangements. Manufacturing methods- Ceramic bearings-Rolling bearing cages-bearing seals selection

UNIT-IV  ROTOR DYNAMICS  9
Motion of the shaft in the bearing- Rotor supported on rigid and flexible supports-Campbell diagram, Rotor Dynamic Analyses- Undamped critical speed - Unbalance response- Damped eigenvalue analysis- Bearing stiffness and damping coefficients- Mechanics of Hydro dynamic Instability- Half frequency whirl and Resonance whip- bearing instability and Oil Whirl Technologies to Improve the Stability of Rotor-bearing Systems--Design configurations of stable journal bearings

UNIT-V  DYNAMICS OF ROTORS MOUNTED ON HYDRODYNAMIC BEARINGS  10
Hydrodynamic Lubrication equation for dynamic loadings-Squeeze film effects in journal bearings and thrust bearings -Rotating loads , alternating and impulse loads in journal bearings – Journal centre Trajectory- Analysis of short bearings under dynamic conditions- Finite difference solution for dynamic conditions

TOTAL =45 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
- understand application of various types of bearings and their operating principles
- design and suggest bearings for specific applications
- perform fatigue life calculations for various types of bearings,
- understand and analyze bearing behavior
- study the dynamics of rotors mounted on Hydrodynamic Bearings
OBJECTIVES:
- To acquaint the students with evolution of Solid Freeform Manufacturing (SFM) / Additive Manufacturing (AM), proliferation into various fields and its effects on supply chain.
- To gain knowledge on Design for Additive Manufacturing (DFAM) and its importance in quality improvement of fabricated parts.
- To acquaint with polymerization and sheet lamination processes and their applications.
- To acquaint with material extrusion and powder bed fusion processes.
- To gain knowledge on jetting and direct energy deposition processes and their applications.

UNIT I INTRODUCTION

UNIT II DESIGN FOR ADDITIVE MANUFACTURING

UNIT III VAT POLYMERIZATION AND SHEET LAMINATION PROCESSES

REFERENCES:

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.9</td>
<td>0.3</td>
</tr>
<tr>
<td>2</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>3</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>4</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>5</td>
<td>0.6</td>
<td>0.6</td>
</tr>
</tbody>
</table>
UNIT IV MATERIAL EXTRUSION AND POWDER BED FUSION PROCESSES 9

UNIT V JETTING AND DIRECT ENERGY DEPOSITION PROCESSES 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students shall be able to:
CO1: Recognize the importance in the evolution of SFM/AM, proliferation into the various fields and its effects on supply chain.
CO2: Evaluate the design for AM and its importance in the quality of fabricated parts.
CO3: Acquire knowledge on principles and applications of polymerization and sheet lamination processes with case studies.
CO4: Acquire knowledge on principles of material extrusion and powder bed fusion processes and design guidelines.
CO5: Perceive jetting and direct energy deposition processes and their applications.

<table>
<thead>
<tr>
<th></th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.6</td>
<td>0.9</td>
<td>0.3</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>1</td>
<td>0.6</td>
<td>0.9</td>
<td>0.3</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>2</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>3</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>4</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>5</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>6</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
<td>0.9</td>
</tr>
</tbody>
</table>

REFERENCES:
OBJECTIVES

- To study concept of Finite Element Analysis to solve problems involving plate and shell elements
- To learn concept of Finite Element Analysis to solve problems involving geometric and material nonlinearity
- To study solution techniques to solve dynamic problems
- To study the concepts of Finite Element Analysis to solve fluid mechanics and heat transfer problems
- To study error norms, convergence rates and refinement.

UNIT-I  BENDING OF PLATES AND SHELLS  9
Review of Elasticity Equations – Bending of Plates and Shells – Finite Element Formulation of Plate and Shell Elements - Conforming and Non-Conforming Elements – C0 and C1 Continuity Elements – Degenerated shell elements- Application and Examples.

UNIT-II  NON-LINEAR PROBLEMS  9

UNIT-III  DYNAMIC PROBLEM  9

UNIT-IV  FLUID MECHANICS AND HEAT TRANSFER  9

UNIT-V  ERROR ESTIMATES AND ADAPTIVE REFINEMENT  9
Error norms and Convergence rates – h-refinement with adaptivity – Adaptive refinement.

TOTAL =45 PERIODS

OUTCOMES:
On Completion of the course the student will be able to

- Apply concept of Finite Element Analysis to solve problems involving plate and shell elements
- Apply concept of Finite Element Analysis to solve problems involving geometric and material nonlinearity
- Formulate solution techniques to solve dynamic problems
- Apply concepts of Finite Element Analysis to solve fluid mechanics and heat transfer problems
- Investigate error norms, convergence rates and refinement.
ED5076        DESIGN OF HYBRID AND ELECTRIC VEHICLES        L    T    P    C
                          3    0    0    3

COURSE OBJECTIVES:
1. Fundamental concepts of electric and hybrid vehicle operation and architectures.
2. Understand the properties of batteries and its types.
3. Provide knowledge about design of series hybrid electric vehicles.
4. Provide knowledge about design of parallel hybrid electric vehicles.
5. Understand of electric vehicle drive train.

UNIT – I   INTRODUCTION TO ELECTRIC VEHICLES
Electric Vehicles (EV) system- EV History – EV advantages – EV market – vehicle mechanics:
roadway fundamentals- law of motion-vehicle kinetics- dynamics of vehicle motion – propulsion
power –velocity and acceleration- propulsion system design.

UNIT – II   ENERGY SOURCE
Battery basics- lead acid battery – alternative batteries – battery parameters - technical
characteristics – battery power – alternative energy sources: Fuel cells - Fuel Cell
characteristics- Fuel cell types.

UNIT – III   SERIES HYBRID ELECTRIC DRIVE TRAIN DESIGN
Operation Patterns- Control Strategies-Sizing of the Major Components -Design of peaking
power source - Traction Motor Size - Design of the Gear Ratio-Verification of Acceleration
Performance-.Verification of gradeability-- Design of Engine/Generator Size - Design of the
Power Capacity - Design of the Energy Capacity -Fuel Consumption.

UNIT – IV   PARALLEL HYBRID ELECTRIC DRIVE TRAIN DESIGN
Control Strategies of Parallel Hybrid Drive Train- Drive Train Parameters- Engine Power
Capacity- Electric Motor Drive Power Capacity- Transmission Design- Energy Storage Design
UNIT – V ELECTRIC VEHICLE DRIVETRAIN


TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Explain how a hybrid vehicle works and describe its main components and their function.
2. Choose proper energy storage systems for vehicle applications.
3. Design series hybrid electric vehicles.
4. Design parallel hybrid electric vehicles.
5. Describe the transmission components and their configurations for electric vehicles.

REFERENCES:
   http://nptel.ac.in/courses/108103009/.

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>0.9</td>
</tr>
<tr>
<td>2</td>
<td>0.3</td>
<td>0.9</td>
</tr>
<tr>
<td>3</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>4</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>5</td>
<td>0.6</td>
<td>0.6</td>
</tr>
</tbody>
</table>

ED5083 TRIBOLOGY IN DESIGN

<table>
<thead>
<tr>
<th>COURSE OBJECTIVES:</th>
</tr>
</thead>
<tbody>
<tr>
<td>To study and measure the different types of surface features associated with the friction of metals and non-metals.</td>
</tr>
<tr>
<td>To study the different types of wear mechanism and surface modification techniques.</td>
</tr>
<tr>
<td>To analyze the various types of lubricants and lubrication system in the tribology.</td>
</tr>
<tr>
<td>To develop the methodology for deciding lubricants and lubrication regimes for different operating conditions.</td>
</tr>
<tr>
<td>To study the different types of high pressure contacts and rolling bearings.</td>
</tr>
</tbody>
</table>

UNIT-I SURFACE INTERACTION AND FRICTION

UNIT-II WEAR AND SURFACE TREATMENT

UNIT-III LUBRICANTS AND LUBRICATION REGIMES

UNIT-IV THEORY OF HYDRODYNAMIC AND HYDROSTATIC LUBRICATION
Reynolds Equation, Assumptions and limitations-One and two dimensional Reynolds Equation Reynolds and Sommerfeld boundary conditions- Pressure wave, flow, load capacity and friction calculations in Hydrodynamic bearings- Long and short bearings- Pad bearings and Journal bearings- Squeeze film effects- Thermal considerations- Hydrostatic lubrication of Pad bearing Pressure, flow, load and friction calculations- Stiffness considerations- Various types of flow restrictors in hydrostatic bearings

UNIT-V HIGH PRESSURE CONTACTS AND ELASTO HYDRODYNAMIC LUBRICATION
Rolling contacts of Elastic solids- contact stresses – Hertzian stress equation- Spherical and cylindrical contacts- Contact Fatigue life- Oil film effects- Elasto Hydrodynamic lubrication Theory Soft and hard EHL Reynolds equation for elasto hydrodynamic lubrication- Film shape within and outside contact zones- Film thickness and friction calculation- Rolling bearings- Stresses and deflections- Traction drives

TOTAL = 45 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
- Develop the knowledge on the surface features and its role on the friction behaviour of metals and nonmetals
- Understand the various types of wear mechanism and surface modification techniques
- Familiarize the different types of lubricants and lubrication systems in the tribology
- Methodology for deciding lubricants and lubrication regimes for different operating conditions
- Ability to understand the different types of high pressure contacts and rolling bearings

REFERENCES:
### COURSE OBJECTIVES:
1. Fundamental concepts related to material handling.
2. Design of various hoisting gears for different material handling applications.
3. Development of conveyor systems for material flow in different industrial production systems.
4. Design of elevators for various manufacturing and service applications.
5. Integrated mechanical system design for machine tools, power transmission, and engine parts.

### UNIT – I INTRODUCTIONS AND DESIGN OF HOISTS

### UNIT – II DRIVES OF HOISTING GEAR
Hand and power drives - Traveling gear - Rail traveling mechanism - Cantilever and monorail cranes - Slewing, jib, and luffing gear - Cogwheel drive - Selecting the motor ratings.

### UNIT – III CONVEYORS
Types - Description - Design and applications of Belt conveyors, apron conveyors, and escalators. Pneumatic conveyors, Screw conveyors, and vibratory conveyors.

### UNIT – IV ELEVATORS
Bucket elevators: design - Loading and bucket arrangements - Cage elevators - Shaft way, guides, counterweights, hoisting machine, safety devices - Design of fork lift trucks.

### UNIT – V INTEGRATED DESIGN
Integrated Design of systems - Valve Gear Mechanisms, Portable Air Compressor, Hay-Bale lifter, Cam Testing Machine, Power Screws, Gear Box Design more than six speed.

**TOTAL: 45 PERIODS**

### COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Design hoists and brakes used in any handling applications.
2. Design drive mechanisms and hoisting gear for different handling applications.
3. Design different conveyor systems for material handling applications.
4. Design bucket, cage, and fork lift elevators for to and fro transportation of materials in vertical direction.
5. Design of integrated mechanical system for machine tools, power transmission, and engine parts.
REFERENCES:

APPROVED DATA BOOKS:

0.3- Low 0.6- Medium 0.9- High

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.3</td>
<td>0.6</td>
<td>0.9</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.3</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>2</td>
<td>0.3</td>
<td>0.6</td>
<td>0.9</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.3</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>3</td>
<td>0.3</td>
<td>0.6</td>
<td>0.9</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.3</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>4</td>
<td>0.3</td>
<td>0.6</td>
<td>0.9</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.3</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>5</td>
<td>0.6</td>
<td>0.6</td>
<td>0.9</td>
<td>0.6</td>
<td>0.6</td>
<td>0.6</td>
<td>0.3</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.6</td>
</tr>
</tbody>
</table>

PD5151 CREATIVITY AND INNOVATION L T P C
3 0 0 3

OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Applying the principles of essential theory of creativity in new product design and development.
2. Applying the principles of various methods and tools for creativity in new product design and development.
3. Applying the design principles of creativity in new product design and development.
4. Applying the various innovation principles and practices in new product design and development.
5. Applying the principles of innovation management in new product design and development.

UNIT – I INTRODUCTION TO ESSENTIAL THEORY OF CREATIVITY 9

UNIT – II METHODS AND TOOLS FOR CREATIVITY 9
Three basic principles behind the tools of directed creativity – Tools that prepare the mind for creative thought – Tools that stimulate the imagination for new idea – Development and action: the bridge between mere creativity and the rewards of innovation - ICEDIP: Inspiration, Clarification, Distillation, Perspiration, Evaluation and Incubation – Creativity and Motivation.
UNIT – III DESIGN AND APPLICATION OF CREATIVITY

Three levels of emotional design: Visceral, Behavioral and Reflective – Process design, reengineering, and creativity – Creativity and customer needs analysis – Innovative product and service design – Creative problem solving and incremental improvement.

UNIT – IV INNOVATION PRINCIPLES & PRACTICES

Methods of Creativity Activation: Morphological Box – Requirements for Inventive Problem Solving – Altshuller’s Engineering Parameters – Altshuller’s Inventive Principles – Altshuller’s Contradiction Matrix Algorithm.

UNIT – IV INNOVATION MANAGEMENT


TOTAL : 45 PERIODS

OUTCOMES:

upon completion of this course, the students will be able to:

1. Apply the principles of essential theory of creativity in new product design and development.
2. Apply the principles of various methods and tools for creativity in new product design and development.
3. Apply the design principles of creativity in new product design and development.
4. Apply the various innovation principles and practices in new product design and development.
5. Apply the principles of innovation management in new product design and development.

REFERENCES:


0.3- Low  
0.6- Medium  
0.9- High  

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>PSO</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.3</td>
<td>0.3</td>
<td>0.6</td>
<td>0.3</td>
<td></td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.3</td>
<td>0.6</td>
<td>0.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.3</td>
<td>0.6</td>
<td>0.9</td>
<td>0.9</td>
<td></td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.3</td>
<td>0.6</td>
<td>0.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.3</td>
<td>0.6</td>
<td>0.9</td>
<td>0.6</td>
<td></td>
<td>0.3</td>
<td>0.6</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td>0.3</td>
<td>0.6</td>
<td>0.3</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.3</td>
<td>0.3</td>
<td>0.9</td>
<td>0.6</td>
<td></td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td>0.6</td>
<td>0.3</td>
<td>0.6</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td>0.3</td>
<td></td>
<td>0.3</td>
<td>0.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.6</td>
<td>0.3</td>
<td>0.6</td>
<td>0.3</td>
<td>0.3</td>
</tr>
</tbody>
</table>
IC5251 COMPUTATIONAL FLUID DYNAMICS L T P C
3 0 0 3

COURSE OBJECTIVES:
- This course aims to introduce numerical modeling and its role in the field of heat, fluid flow and combustion it will enable the students to understand the various discretisation methods and solving methodologies and to create confidence to solve complex problems in the field of heat transfer and fluid dynamics.
- To develop finite volume discretised forms of the governing equations for diffusion processes.
- To develop finite volume discretised forms of the convection-diffusion processes.
- To develop pressure based algorithms for flow processes.
- To introduce various turbulence models, Large Eddy Simulation and Direct Numerical Simulation.

UNIT – I GOVERNING DIFFERENTIAL EQUATIONS AND DISCRETISATION TECHNIQUES 8

UNIT – II DIFFUSION PROCESSES : FINITE VOLUME METHOD 10

UNIT – III CONVECTION-DIFFUSION PROCESSES : FINITE VOLUME METHOD 9
One dimensional convection – diffusion problem, Central difference scheme, upwind scheme – Hybrid and power law discretization techniques – QUICK scheme.

UNIT – IV FLOW PROCESSES : FINITE VOLUME METHOD 8
Discretisation of incompressible flow equations – Pressure based algorithms, SIMPLE, SIMPLER & PISO algorithms.

UNIT – V TURBULENCE MODELS 10
Turbulence – RANS equation - Algebraic Models, One equation model, Two equation models – k- & standard k – ε model, Low Reynold number models of k- ε, Large Eddy Simulation (LES), Direct Numerical Simulation (DNS) - Introduction. Solving simple cases using standard CFD codes.

TOTAL:45 PERIODS

COURSE OUTCOMES:
On successful completion of this course the students will be able to:
- Analyse the governing equations and boundary conditions.
- Analyse various discretization techniques for both steady and unsteady diffusion problems.
- Analyse the various convection-diffusion problems by Finite-Volume method.
- Analyse the flow processes by using different pressure bound algorithms.
- Select and use the different turbulence models according to the type of flows.

REFERENCES:


<table>
<thead>
<tr>
<th>CO</th>
<th>0.3- Low</th>
<th>0.6- Medium</th>
<th>0.9- High</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10 11 12</td>
<td>1 2 3</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.9 0.6 0.6 0.3 0.3</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.9 0.6 0.6 0.3 0.6</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.3 0.3 0.3 0.3 0.3</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.3 0.3 0.3 0.3 0.3</td>
<td>0.3</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0.3 0.3 0.3 0.3 0.3</td>
<td>0.3</td>
<td></td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:

- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I  OVERVIEW OF BUSINESS ANALYTICS  9

Suggested Activities:

- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:

- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II  ESSENTIALS OF BUSINESS ANALYTICS  9

Suggested Activities:

- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:

- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III  MODELING UNCERTAINTY AND STATISTICAL INFERENCE  9

Suggested Activities:

- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:

- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.
UNIT IV  ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK


Suggested Activities:
- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:
- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V  OTHER DATA ANALYTICAL FRAMEWORKS

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:
- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:
- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student will be able to:
- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
- Use open source frameworks for modeling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:
OBJECTIVES:

- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I  INTRODUCTION  9
Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II  FUNDAMENTALS OF MAINTENANCE ENGINEERING  9
Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III  WEAR AND CORROSION AND THEIR PREVENTION  9

UNIT IV  FAULT TRACING  9
Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V  PERIODIC AND PREVENTIVE MAINTENANCE  9
Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

OUTCOMES:

CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

<table>
<thead>
<tr>
<th></th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO2</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO3</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO4</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>PO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>PO6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
REFERENCES:

OE5093 OPERATIONS RESEARCH

OBJECTIVES:
- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation, assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I LINEAR PROGRAMMING
Introduction to Operations Research – assumptions of linear programming problems – Formulations of linear programming problem – Graphical method

UNIT II ADVANCES IN LINEAR PROGRAMMING
Solutions to LPP using simplex algorithm - Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III NETWORK ANALYSIS – I
Transportation problems - Northwest corner rule, least cost method, Voges's approximation method - Assignment problem - Hungarian algorithm

UNIT IV NETWORK ANALYSIS – II
Shortest path problem: Dijkstra's algorithms, Floyds algorithm, systematic method - CPM/PERT

UNIT V NETWORK ANALYSIS – III
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL: 45 PERIODS

OUTCOMES:
CO1: To formulate linear programming problem and solve using graphical method.
CO2: To solve LPP using simplex method
CO3: To formulate and solve transportation, assignment problems
CO4: To solve project management problems
CO5: To solve scheduling problems

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:
OBJECTIVES:
- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING CONCEPTS
Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II INTRODUCTION TO PROJECT MANAGEMENT
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning, Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.

UNIT III PROJECT EXECUTION AND COSTING CONCEPTS
Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL
Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

OUTCOMES
- CO1 – Understand the costing concepts and their role in decision making
- CO2–Understand the project management concepts and their various aspects in selection
- CO3–Interpret costing concepts with project execution
- CO4–Gain knowledge of costing techniques in service sector and various budgetary control techniques
- CO5 - Become familiar with quantitative techniques in cost management
REFERENCES:
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988

OE5095 COMPOSITE MATERIALS

OBJECTIVES:
- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT I INTRODUCTION
Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II REINFORCEMENTS
Preparation - layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES

UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES

UNIT V STRENGTH
Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 PERIODS
OUTCOMES:
- CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
- CO2 – Know the various reinforcements used in composite materials.
- CO3 – Understand the manufacturing processes of metal matrix composites.
- CO4 – Understand the manufacturing processes of polymer matrix composites.
- CO5 – Analyze the strength of composite materials.

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:

OE5096 WASTE TO ENERGY L T P C
3 0 0 3

OBJECTIVES:
- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNIT I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE
Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II BIOMASS PYROLYSIS
Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION

UNIT IV BIOMASS COMBUSTION
Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V BIO ENERGY
Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass
gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

OUTCOMES:
CO1 – Understand the various types of wastes from which energy can be generated
CO2 – Gain knowledge on biomass pyrolysis process and its applications
CO3 – Develop knowledge on various types of biomass gasifiers and their operations
CO4 – Gain knowledge on biomass combustors and its applications on generating energy
CO5 – Understand the principles of bio-energy systems and their features

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>

REFERENCES:
OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I  INTRODUCTION TO RESEARCH PAPER WRITING 6
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II  PRESENTATION SKILLS 6

UNIT III  TITLE WRITING SKILLS 6
Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV  RESULT WRITING SKILLS 6
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V  VERIFICATION SKILLS 6
Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first-time submission

TOTAL: 30 PERIODS

OUTCOMES

CO1 – Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

<table>
<thead>
<tr>
<th>CO1</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

REFERENCES

OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS

UNIT III DISASTER PRONE AREAS IN INDIA
Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

TOTAL: 30 PERIODS

OUTCOMES

CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
REFERENCES

AX5093 SANSKRIT FOR TECHNICAL KNOWLEDGE

OBJECTIVES
- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I ALPHABETS
Alphabets in Sanskrit

UNIT II TENSES AND SENTENCES
Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS
Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE
Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING
Technical concepts of Engineering - Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

OUTCOMES
- CO1 - Understanding basic Sanskrit language.
- CO2 - Write sentences.
- CO3 - Know the order and roots of Sanskrit.
- CO4 - Know about technical information about Sanskrit literature.
- CO5 - Understand the technical concepts of Engineering.

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>✅</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>✅</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td>✅</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✅</td>
</tr>
</tbody>
</table>

REFERENCES
1. “Abhyaasapustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbashastrl, Rashtriya Sanskrit Sansthanam, New Delhi Publication
OBJECTIVES
Students will be able to
- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I

UNIT II

UNIT III

UNIT IV

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to
- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

SUGGESTED READING

AX5095 CONSTITUTION OF INDIA

OBJECTIVES
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION:
History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION:
Preamble, Salient Features
UNIT III  CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:
Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to
Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive
Principles of State Policy, Fundamental Duties.

UNIT IV  ORGANS OF GOVERNANCE:
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive,
President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges,
Qualifications, Powers and Functions.

UNIT V  LOCAL ADMINISTRATION:
District’s Administration head: Role and Importance, Municipalities: Introduction, Mayor and role
Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level:
Organizational Hierarchy(Different departments), Village level: Role of Elected and Appointed
officials, Importance of grass root democracy.

UNIT VI  ELECTION COMMISSION:
Election Commission: Role and Functioning. Chief Election Commissioner and Election
Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to:
- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the
  arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the
  conceptualization
  of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP]
  under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct
  elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING
1. The Constitution of India,1950(Bare Act),Government Publication.

AX5096  PEDAGOGY STUDIES

OBJECTIVES
Students will be able to:
- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I  INTRODUCTION AND METHODOLOGY:
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of
learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview
of methodology and Searching.
UNIT II  THEMATIC OVERVIEW
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III  EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers’ attitudes and beliefs and Pedagogic strategies.

UNIT IV  PROFESSIONAL DEVELOPMENT
Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V  RESEARCH GAPS AND FUTURE DIRECTIONS
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

OUTCOMES
Students will be able to understand:
- What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

TOTAL: 30 PERIODS

SUGGESTED READING
OBJECTIVES
- To achieve overall health of body and mind
- To overcome stress

UNIT I
Definitions of Eight parts of yoga.(Ashtanga)

UNIT II
Yam and Niyam - Do’s and Don’ts in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III
Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects - Types of pranayam

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to:
- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING
1. “Yogic Asanas for Group Tarining-Part-I”:Janardan Swami Yoga bhyasi Mandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

OBJECTIVES
- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I
Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont’s) - Verses- 71,73,75,78 (do’s)

UNIT II
Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to
- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.
SUGGESTED READING
1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari’s Three Satakam, Niti-sringar-vairagya, New Delhi, 2010