B.E. INDUSTRIAL ENGINEERING AND MANAGEMENT

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

<table>
<thead>
<tr>
<th>I.</th>
<th>To develop students to start carrier as an effective engineer by applying skills to create road map for success and development in Industries</th>
</tr>
</thead>
<tbody>
<tr>
<td>II.</td>
<td>To enrich the knowledge of students to Create, Extend, Execute and manage new flexible system by breakdown complex</td>
</tr>
<tr>
<td>III.</td>
<td>To train the students with capability to manage man, machine, money and materials for the development of industry</td>
</tr>
<tr>
<td>IV.</td>
<td>To train the students with ability to easily adapt on changes and demand with modern technological and global.</td>
</tr>
<tr>
<td>V.</td>
<td>To train the students with extensive skills on problem solving for the development of industries on high risk demands.</td>
</tr>
</tbody>
</table>

PROGRAM OUTCOMES (POs):

<table>
<thead>
<tr>
<th>PO#</th>
<th>Graduate Attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Engineering knowledge</strong>: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Problem analysis</strong>: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.</td>
</tr>
<tr>
<td>3</td>
<td><strong>Design/development of solutions</strong>: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural, societal and environmental considerations.</td>
</tr>
<tr>
<td>4</td>
<td><strong>Conduct investigations of complex problems</strong>: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.</td>
</tr>
<tr>
<td>5</td>
<td><strong>Modern tool usage</strong>: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.</td>
</tr>
<tr>
<td>6</td>
<td><strong>The engineer and society</strong>: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the</td>
</tr>
</tbody>
</table>
consequent responsibilities relevant to the professional engineering practice.

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

8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9 Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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

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

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

PROGRAM SPECIFIC OUTCOMES (PSOs):

1. Design, develop, implement and improve integrated systems that include people, materials, information, equipment and energy.

2. Apply statistical and simulation tools, optimization and meta heuristics techniques for analysis of various systems leading to better decision making.

3. Demonstrate the engineering relationships between the management tasks of planning, organization, leadership, control, and the human element in various sectors of economy

PEO's – PO's & PSO's MAPPING:

<table>
<thead>
<tr>
<th>PEO</th>
<th>PO</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>I.</td>
<td></td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>II.</td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>III.</td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>IV.</td>
<td></td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>V.</td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>VI.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
### PROGRAM ARTICULATION MATRIX

<table>
<thead>
<tr>
<th>Year</th>
<th>Sem</th>
<th>Course name</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>I I</td>
<td></td>
<td>Professional English - I</td>
<td>1.6</td>
<td>2.2</td>
<td>1.8</td>
<td>1.6</td>
<td>1.5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1.6</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Matrices and Calculus</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engineering Physics</td>
<td>3</td>
<td>3</td>
<td>1.6</td>
<td>1.6</td>
<td>1.2</td>
<td>1</td>
<td>1.8</td>
<td>1.8</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engineering Chemistry</td>
<td>2.8</td>
<td>1.3</td>
<td>1.6</td>
<td>1</td>
<td>1</td>
<td>1.5</td>
<td>1.8</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.5</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Problem Solving and Python Programming</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>தமிழ் / Heritage of Tamils</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>
<tr>
<td></td>
<td></td>
<td>Problem Solving and Python Programming Laboratory</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Physics and Chemistry Laboratory</td>
<td>2.6</td>
<td>1.5</td>
<td>1.5</td>
<td>1</td>
<td>1.4</td>
<td>1.8</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.3</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>English Laboratory&lt;sup&gt;a&lt;/sup&gt;</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Professional English - II</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2.75</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2.2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Statistics and Numerical Methods</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Materials Science</td>
<td>3</td>
<td>2</td>
<td>1.6</td>
<td>1.4</td>
<td>1.8</td>
<td>1.2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Basic Electrical and Electronics Engineering</td>
<td>2</td>
<td>1.8</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td></td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engineering Graphics</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>தமிழ் / Tamils and Technology</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>
<tr>
<td></td>
<td></td>
<td>NCC Credit Course Level 1&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engineering Practices Laboratory</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Basic Electrical and Electronics Engineering Laboratory</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Communication Laboratory / Foreign Language&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.4</td>
<td>2.6</td>
<td>3</td>
<td>3</td>
<td>1.8</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Probability and Linear Algebra</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>
<tr>
<td></td>
<td></td>
<td>Fluid Mechanics and Machinery</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</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>Strength of Materials</td>
<td>3</td>
<td>2.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Work System design</td>
<td>1.5</td>
<td>2</td>
<td>3</td>
<td>2.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engineering Mechanics</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Manufacturing Processes</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strength of Materials and Fluid Machinery Laboratory</td>
<td>2.7</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Manufacturing Technology Laboratory</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Professional 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>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operations Research</td>
<td>2.4</td>
<td>2.4</td>
<td>3</td>
<td>2.4</td>
<td>2.6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.5</td>
<td>1.6</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thermodynamics</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2.6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.4</td>
<td>3</td>
<td>2.4</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Applied Ergonomics</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2.6</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1.3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Human Resource Management</td>
<td>3</td>
<td>3</td>
<td>1.8</td>
<td>2.6</td>
<td>2</td>
<td>2.6</td>
<td>2</td>
<td>2.2</td>
<td>1.8</td>
<td>1.8</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>1.4</td>
<td>1.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mechanics of Machines</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Environmental Science and Sustainability</td>
<td>2.8</td>
<td>1.8</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.8</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NCC Credit Course Level 2&lt;sup&gt;a&lt;/sup&gt;</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Work System Design and Ergonomics Laboratory</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Optimization Laboratory</td>
<td>3</td>
<td>2.6</td>
<td>3</td>
<td>2.7</td>
<td>2.3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.5</td>
<td>3</td>
<td>2.5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engineering Quality Control</td>
<td>2</td>
<td>2.2</td>
<td>2</td>
<td>2.2</td>
<td>1.8</td>
<td>1.6</td>
<td>2</td>
<td>2</td>
<td>1.8</td>
<td>1.4</td>
<td>1.8</td>
<td>2.4</td>
<td>1.8</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Production and Operations Management</td>
<td>3</td>
<td>2.6</td>
<td>3</td>
<td>2.6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mandatory Course-I&lt;sup&gt;a&lt;/sup&gt;</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>
<tr>
<td></td>
<td></td>
<td>Computer Aided Machine Drawing</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Management Accounting and Financial Management</td>
<td>-</td>
<td>2.5</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>2.5</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Simulation Modeling and Analysis</td>
<td>2.6</td>
<td>3</td>
<td>2.6</td>
<td>2.7</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mandatory Course-II&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2.6</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2.5</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>NCC Credit Course Level 3&lt;sup&gt;a&lt;/sup&gt;</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>2.6</td>
<td>2.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Systems Simulation Laboratory</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supply Chain Management</td>
<td>-</td>
<td>2.8</td>
<td>3</td>
<td>2</td>
<td>2.5</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Decision Support and Intelligent Systems</td>
<td>-</td>
<td>2.8</td>
<td>3</td>
<td>2</td>
<td>2.5</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>2.6</td>
<td>2.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Human Values and Ethics</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>
<tr>
<td></td>
<td></td>
<td>Elective – 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>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Data Analytics Laboratory</td>
<td>2.4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project Work / Internship</td>
<td>2.6</td>
<td>2.4</td>
<td>2.3</td>
<td>2.2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.2</td>
<td>2.6</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> NCC Credit Course Level 1, 2, 3

<sup>b</sup> Communication Laboratory / Foreign Language
### 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>Total Contact Periods</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>IP3151</td>
<td>Induction Programme</td>
<td></td>
<td>-</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>HS3152</td>
<td>Professional English - I</td>
<td>HSMC</td>
<td>3 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>MA3151</td>
<td>Matrices and Calculus</td>
<td>BSC</td>
<td>3 1</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>4.</td>
<td>PH3151</td>
<td>Engineering Physics</td>
<td>BSC</td>
<td>3 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CY3151</td>
<td>Engineering Chemistry</td>
<td>BSC</td>
<td>3 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>GE3151</td>
<td>Problem Solving and Python Programming</td>
<td>ESC</td>
<td>3 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>GE3152</td>
<td>மரபு/ Heritage of Tamils</td>
<td>HSMC</td>
<td>1 0</td>
<td>1</td>
<td>1</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>7</td>
<td>GE3171</td>
<td>Problem Solving and Python Programming</td>
<td>ESC</td>
<td>0 0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>BS3171</td>
<td>Physics and Chemistry Laboratory</td>
<td>BSC</td>
<td>0 0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>GE3172</td>
<td>English Laboratory</td>
<td>EEC</td>
<td>0 0</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

**TOTAL** 14 1 16 31 23

---

### 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>Total Contact Periods</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>HS3252</td>
<td>Professional English - II</td>
<td>HSMC</td>
<td>2 0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>MA3251</td>
<td>Statistics and Numerical Methods</td>
<td>BSC</td>
<td>3 1</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>PH3251</td>
<td>Materials Science</td>
<td>BSC</td>
<td>3 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>BE3251</td>
<td>Basic Electrical and Electronics Engineering</td>
<td>ESC</td>
<td>3 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>GE3251</td>
<td>Engineering Graphics</td>
<td>ESC</td>
<td>2 0</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>6.</td>
<td>GE3252</td>
<td>மரபு/ Heritage of Tamils</td>
<td>HSMC</td>
<td>1 0</td>
<td>1</td>
<td>1</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>8</td>
<td>GE3271</td>
<td>Engineering Practices Laboratory</td>
<td>ESC</td>
<td>0 0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>BE3271</td>
<td>Basic Electrical and Electronics Engineering Laboratory</td>
<td>ESC</td>
<td>0 0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>GE3272</td>
<td>Communication Laboratory / Foreign Language</td>
<td>EEC</td>
<td>0 0</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

**TOTAL** 14 1 16 31 23

---

*NCC Credit Course level 1 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.*

*Skill Based Course*
### SEMESTER III

<table>
<thead>
<tr>
<th>S. 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><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>MA3352</td>
<td>Probability and Linear Algebra</td>
<td>BSC</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>CE3391</td>
<td>Fluid Mechanics and Machinery</td>
<td>ESC</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>CE3491</td>
<td>Strength of Materials</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>IE3351</td>
<td>Work System Design</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>ME3351</td>
<td>Engineering Mechanics</td>
<td>ESC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>ME3393</td>
<td>Manufacturing Processes</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>CE3481</td>
<td>Strength of Materials and Fluid</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Machinery Laboratory</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>ME3382</td>
<td>Manufacturing Technology</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>9.</td>
<td>GE3361</td>
<td>Professional Development$^{5}$</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td>18</td>
<td>2</td>
<td>10</td>
</tr>
</tbody>
</table>

$^{5}$ Skill Based Course

### SEMESTER IV

<table>
<thead>
<tr>
<th>S. 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><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>IE3491</td>
<td>Operations Research</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>IE3451</td>
<td>Thermodynamics</td>
<td>PCC</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>IE3452</td>
<td>Applied Ergonomics</td>
<td>PCC</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>IM3401</td>
<td>Human Resource Management</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>AE3491</td>
<td>Mechanics of Machines</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>GE3451</td>
<td>Environmental Sciences and Sustainability</td>
<td>BSC</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7.</td>
<td>NCC Credit Course Level 2$^{*}$</td>
<td></td>
<td></td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td>18</td>
<td>1</td>
<td>6</td>
</tr>
</tbody>
</table>

$^{*}$ NCC Credit Course level 2 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA.
### SEMESTER V

<table>
<thead>
<tr>
<th>S. 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><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>IE3453</td>
<td>Engineering Quality Control</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>IE3551</td>
<td>Production and Operations Management</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>Professional Elective I</td>
<td>PEC</td>
<td>- - -</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>Professional Elective II</td>
<td>PEC</td>
<td>- - -</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>Professional Elective III</td>
<td>PEC</td>
<td>- - -</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Professional Elective IV</td>
<td>PEC</td>
<td>- - -</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td>Mandatory Course-I*</td>
<td>MC</td>
<td>3 0 0</td>
<td>3</td>
<td>Non-Credit Course</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>ME3381</td>
<td>Computer Aided Machine Drawing</td>
<td>PCC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td>20</td>
</tr>
</tbody>
</table>

* Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under MCI)

### SEMESTER VI

<table>
<thead>
<tr>
<th>S. 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><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>CIE359</td>
<td>Management Accounting and Financial Management</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>IE3791</td>
<td>Simulation Modeling and Analysis</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>Open Elective – I*</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>Professional Elective V</td>
<td>PEC</td>
<td>- - -</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>Professional Elective VI</td>
<td>PEC</td>
<td>- - -</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Professional Elective VII</td>
<td>PEC</td>
<td>- - -</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td>Professional Elective VIII</td>
<td>PEC</td>
<td>- - -</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td></td>
<td>Mandatory Course-II &amp;</td>
<td>MC</td>
<td>3 0 0</td>
<td>3</td>
<td>Non-Credit Course</td>
</tr>
<tr>
<td>9.</td>
<td></td>
<td>NCC Credit Course Level 3#</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>IE3781</td>
<td>Systems Simulation Laboratory</td>
<td>PCC</td>
<td>0 0 2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td>22</td>
</tr>
</tbody>
</table>

*Open Elective – I shall be chosen from the emerging technologies.

* Mandatory Course-I is a Non-credit Course (Student shall select one course from the list given under MCI)

# NCC Credit Course level 3 is offered for NCC students only. The grades earned by the students will be recorded in the Mark Sheet, however the same shall not be considered for the computation of CGPA
### SEMESTER VII/VIII*

<table>
<thead>
<tr>
<th>S. 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><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>IE3792</td>
<td>Supply Chain Management</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>CIE363</td>
<td>Decision Support and Intelligent Systems</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>GE3791</td>
<td>Human Values and Ethics</td>
<td>HSMC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>Elective – Management #</td>
<td>HSMC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>Open Elective – II**</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Open Elective – III***</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td>Open Elective – IV***</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>IM3711</td>
<td>Data Analytics Laboratory</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>21</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

*If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII.

**Open Elective – II shall be chosen from the emerging technologies.

***Open Elective III and IV (Shall be chosen from the list of open electives offered by other Programmes).

# Elective - Management shall be chosen from the elective Management courses

### SEMESTER VIII/VII*

<table>
<thead>
<tr>
<th>S. 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><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>IM3811</td>
<td>Project Work / Internship</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
</tbody>
</table>

*If students undergo internship in Semester VII, then the courses offered during semester VII will be offered during semester VIII

TOTAL NO OF CREDITS: 166
### ELECTIVE – MANAGEMENT COURSES

<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>GE3751</td>
<td>Principles of Management</td>
<td>HSMC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>GE3752</td>
<td>Total Quality Management</td>
<td>HSMC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>GE3753</td>
<td>Engineering Economics and Financial Accounting</td>
<td>HSMC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>GE3754</td>
<td>Human Resource Management</td>
<td>HSMC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>GE3755</td>
<td>Knowledge Management</td>
<td>HSMC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>GE3792</td>
<td>Industrial Management</td>
<td>HSMC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

### MANDATORY COURSES I*

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MX3081</td>
<td>Introduction to Women and Gender Studies</td>
<td>MC</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>MX3082</td>
<td>Elements of Literature</td>
<td>MC</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>MX3083</td>
<td>Film Appreciation</td>
<td>MC</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>MX3084</td>
<td>Disaster Risk Reduction and Management</td>
<td>MC</td>
<td>3 0 0</td>
<td>3</td>
</tr>
</tbody>
</table>

*Mandatory Courses are offered as Non-Credit courses

### MANDATORY COURSES II*

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MX3085</td>
<td>Well Being with Traditional Practices - Yoga, Ayurveda and Siddha</td>
<td>MC</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>MX3086</td>
<td>History of Science and Technology in India</td>
<td>MC</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>MX3087</td>
<td>Political and Economic Thought for a Humane Society</td>
<td>MC</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>MX3088</td>
<td>State, Nation Building and Politics in India</td>
<td>MC</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>MX3089</td>
<td>Industrial Safety</td>
<td>MC</td>
<td>3 0 0</td>
<td>3</td>
</tr>
</tbody>
</table>

*Mandatory Courses are offered as Non-Credit courses
<table>
<thead>
<tr>
<th>Vertical 1</th>
<th>Vertical 2</th>
<th>Vertical 3</th>
<th>Vertical 4</th>
<th>Vertical 5</th>
<th>Vertical 6</th>
<th>Vertical 7</th>
<th>Vertical 8</th>
<th>Vertical 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Process Re-engineering</td>
<td>Lean and Agile Manufacturing</td>
<td>Design of Experiments</td>
<td>Agile Software Development</td>
<td>Robotics</td>
<td>Design For X</td>
<td>Green Manufacturing Design and Practices</td>
<td>Technology Management</td>
<td>-</td>
</tr>
<tr>
<td>Supply Chain Risk Management</td>
<td>Advanced Optimization Techniques</td>
<td>Lean Six Sigma</td>
<td>Software Metrics and Quality Audit</td>
<td>Drone Technologies</td>
<td>Product Life Cycle Management</td>
<td>Green Supply Chain Management</td>
<td>Human Rights and Industrial Laws</td>
<td>Organizational Behaviour</td>
</tr>
<tr>
<td>Logistics Management</td>
<td>-</td>
<td>Multivariate Data Analysis</td>
<td>Business Data Analytics</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Industry 4.0</td>
</tr>
</tbody>
</table>

**Registration of Professional Elective Courses from Verticals:**

Refer to the Regulations 2021, Clause 6.3. (Amended on 27.07.2023)
## PROFESSIONAL ELECTIVE COURSES: VERTICALS

### VERTICAL 1: OPERATIONS AND SUPPLY CHAIN MANAGEMENT

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>Periods Perweek</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>CIE331</td>
<td>Project Management</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>CIE332</td>
<td>Product Design and Value Engineering</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>CIE333</td>
<td>Facility Design</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>CIE334</td>
<td>Business Process Re-engineering</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>CIE335</td>
<td>Enterprise Resource Planning</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>CIE336</td>
<td>Cost Estimation and Control</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7.</td>
<td>CIE337</td>
<td>Supply Chain Risk Management</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8.</td>
<td>CIE338</td>
<td>Logistics Management</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

### VERTICAL 2: MANUFACTURING SYSTEMS

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>Periods Perweek</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>CIE339</td>
<td>Systems Engineering</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>ME3792</td>
<td>Computer Integrated Manufacturing</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>CIE340</td>
<td>Flexible Manufacturing Systems</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>CIE341</td>
<td>Lean and Agile Manufacturing</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>CIE342</td>
<td>Operations Scheduling</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td>CIE343</td>
<td>Modelling of Manufacturing Systems</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7.</td>
<td>CIE344</td>
<td>Advanced Optimization Techniques</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
### VERTICAL 3: QUALITY SYSTEMS

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>Periods Perweek</th>
<th>Total 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>1.</td>
<td>ME3592</td>
<td>Metrology and Measurements</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CIE345</td>
<td>Quality Assurance and Auditing</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CIE346</td>
<td>Maintenance Engineering</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CIE347</td>
<td>Design of Experiments</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CIE348</td>
<td>Reliability Engineering</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>CIE349</td>
<td>Advanced Measurement System</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>CIE350</td>
<td>Lean Six Sigma</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>CIE351</td>
<td>Multivariate Data Analysis</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

### VERTICAL 4: SOFTWARE QUALITY ENGINEERING

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>Periods Perweek</th>
<th>Total 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>1.</td>
<td>CIE356</td>
<td>Database Management System</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CIE352</td>
<td>Design and Analysis of Algorithms</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CIE353</td>
<td>Software Cost Estimation</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CIE354</td>
<td>Agile Software Development</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CIE355</td>
<td>Software Quality Management</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>CIE356</td>
<td>Software Testing</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>CIE357</td>
<td>Software Metrics and Quality Audit</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>CIE358</td>
<td>Business Data Analytics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
# VERTICAL 5: ROBOTICS AND AUTOMATION

<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 Period</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MR3491</td>
<td>Sensors and Instrumentation</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>MR3392</td>
<td>Electrical Drives and Actuators</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>MR3492</td>
<td>Embedded Systems and Programming</td>
<td>PEC</td>
<td>2 0 2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>MR3691</td>
<td>Robotics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CMR338</td>
<td>Smart mobility and Intelligent Vehicles</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>CME345</td>
<td>Haptics and Immersive Technologies</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>CRA332</td>
<td>Drone Technologies</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

# VERTICAL 6: PRODUCT AND PROCESS DEVELOPMENT

<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 Period</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CME338</td>
<td>Value Engineering</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CME339</td>
<td>Additive Manufacturing</td>
<td>PEC</td>
<td>2 0 2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CME340</td>
<td>CAD/CAM</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CME341</td>
<td>Design For X</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CME342</td>
<td>Ergonomics in Design</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>CME343</td>
<td>New Product Development</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>CME344</td>
<td>Product Life Cycle Management</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
### VERTICAL 7: DIGITAL AND GREEN MANUFACTURING

<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 period</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CME346</td>
<td>Digital Manufacturing and IoT</td>
<td>PEC</td>
<td>L 2 T 0 P 2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CME347</td>
<td>Lean Manufacturing</td>
<td>PEC</td>
<td>L 3 T 0 P 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CME348</td>
<td>Modern Robotics</td>
<td>PEC</td>
<td>L 2 T 0 P 2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CME349</td>
<td>Green Manufacturing Design and Practices</td>
<td>PEC</td>
<td>L 3 T 0 P 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CME350</td>
<td>Environment Sustainability and Impact Assessment</td>
<td>PEC</td>
<td>L 3 T 0 P 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>CME351</td>
<td>Energy Saving Machinery and Components</td>
<td>PEC</td>
<td>L 3 T 0 P 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>CME352</td>
<td>Green Supply Chain Management</td>
<td>PEC</td>
<td>L 3 T 0 P 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

### VERTICAL 8: DIVERSIFIED COURSES GROUP 1

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>Periods Perweek</th>
<th>Total contact periods</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CIM331</td>
<td>Services Operations Management</td>
<td>PEC</td>
<td>L 3 T 0 P 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CIE360</td>
<td>Design Thinking and Innovation</td>
<td>PEC</td>
<td>L 3 T 0 P 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CAU331</td>
<td>Intellectual Property Rights</td>
<td>PEC</td>
<td>L 3 T 0 P 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CIM332</td>
<td>Technology Management</td>
<td>PEC</td>
<td>L 3 T 0 P 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CIM333</td>
<td>Strategic Management</td>
<td>PEC</td>
<td>L 3 T 0 P 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>CIE364</td>
<td>Safety Engineering and Management</td>
<td>PEC</td>
<td>L 3 T 0 P 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>CIM334</td>
<td>Human Rights and Industrial Laws</td>
<td>PEC</td>
<td>L 3 T 0 P 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>CIE361</td>
<td>Productivity Management and Re-engineering</td>
<td>PEC</td>
<td>L 3 T 0 P 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
### VERTICAL 9: DIVERSIFIED COURSES GROUP 2

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course code</th>
<th>Course Title</th>
<th>Category</th>
<th>Periods Perweek</th>
<th>Total Contact Periods</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CIM335</td>
<td>Healthcare Operations Management</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CIE362</td>
<td>Entrepreneurship Development</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CSF331</td>
<td>Disaster Management</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CME396</td>
<td>Process Planning and Cost Estimation</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CIM336</td>
<td>Marketing Management</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>CIM337</td>
<td>Organizational Behaviour</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>CMF340</td>
<td>Industry 4.0</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

**OPEN ELECTIVES**

(Students shall choose the open elective courses, such that the course contents are not similar to any other course contents/title under other course categories).

**OPEN ELECTIVE I AND II**

(EMERGING TECHNOLOGIES)

To be offered other than Faculty of Information and Communication Engineering

<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>OCS351</td>
<td>Artificial Intelligence and Machine Learning Fundamentals</td>
<td>OEC</td>
<td>2 0 2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>OCS352</td>
<td>IoT Concepts and Applications</td>
<td>OEC</td>
<td>2 0 2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>OCS353</td>
<td>Data Science Fundamentals</td>
<td>OEC</td>
<td>2 0 2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CCS333</td>
<td>Augmented Reality / Virtual Reality</td>
<td>OEC</td>
<td>2 0 2</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

**OPEN 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>OHS351</td>
<td>English for Competitive Examinations</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>OMG352</td>
<td>NGOs and Sustainable Development</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>OMG353</td>
<td>Democracy and Good Governance</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>OCE353</td>
<td>Lean Concepts, Tools And Practices</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>OME365</td>
<td>Renewable Energy</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Course Code</td>
<td>Course Title</td>
<td>Department</td>
<td>Lecture</td>
<td>Practical</td>
<td>Theory</td>
</tr>
<tr>
<td>---</td>
<td>-------------</td>
<td>---------------------------------------------</td>
<td>------------</td>
<td>---------</td>
<td>-----------</td>
<td>--------</td>
</tr>
<tr>
<td>6</td>
<td>OME354</td>
<td>Applied Design Thinking</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>MF3003</td>
<td>Reverse Engineering</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>OPR351</td>
<td>Sustainable Manufacturing</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>AU3791</td>
<td>Electric and Hybrid Vehicles</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>OAS352</td>
<td>Space Engineering</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11</td>
<td>OIE354</td>
<td>Quality Engineering</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>OSF351</td>
<td>Fire Safety Engineering</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>13</td>
<td>OML351</td>
<td>Introduction to non-destructive testing</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>14</td>
<td>OMR351</td>
<td>Mechatronics</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>15</td>
<td>OAA351</td>
<td>Foundation of Robotics</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>16</td>
<td>OAE352</td>
<td>Fundamentals of Aeronautical Engineering</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>17</td>
<td>OGI351</td>
<td>Remote Sensing Concepts</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>18</td>
<td>OAI351</td>
<td>Urban Agriculture</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>19</td>
<td>OEN351</td>
<td>Drinking Water Supply and Treatment</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>20</td>
<td>OEE352</td>
<td>Electric Vehicle technology</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>21</td>
<td>OI353</td>
<td>Introduction to PLC Programming</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>22</td>
<td>OCH351</td>
<td>Nano Technology</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>23</td>
<td>OCH352</td>
<td>Functional Materials</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>24</td>
<td>OFD352</td>
<td>Traditional Indian Foods</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>25</td>
<td>OFD353</td>
<td>Introduction to food processing</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>26</td>
<td>OPY352</td>
<td>IPR for Pharma Industry</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>27</td>
<td>OTT351</td>
<td>Basics of Textile Finishing</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>28</td>
<td>OTT352</td>
<td>Industrial Engineering for Garment Industry</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>29</td>
<td>OTT353</td>
<td>Basics of Textile Manufacture</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>30</td>
<td>OPE351</td>
<td>Introduction to Petroleum Refining and Petrochemicals</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>31</td>
<td>OPE334</td>
<td>Energy Conservation and Management</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>32</td>
<td>OPT351</td>
<td>Basics of Plastics Processing</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>33</td>
<td>OEC351</td>
<td>Signals and Systems</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>34</td>
<td>OEC352</td>
<td>Fundamentals of Electronic Devices and Circuits</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>35</td>
<td>OBM348</td>
<td>Foundation Skills in integrated product Development</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>36</td>
<td>OBM333</td>
<td>Assistive Technology</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>37</td>
<td>OMA352</td>
<td>Operations Research</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>38</td>
<td>OMA353</td>
<td>Algebra and Number Theory</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>39</td>
<td>OMA354</td>
<td>Linear Algebra</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>40</td>
<td>OBT352</td>
<td>Basics of Microbial Technology</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>41</td>
<td>OBT353</td>
<td>Basics of Biomolecules</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SL. NO.</td>
<td>COURSE CODE</td>
<td>COURSE TITLE</td>
<td>CATEGORY</td>
<td>PERIODS PER WEEK</td>
<td>TOTAL CONTACT PERIODS</td>
<td>CREDITS</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td>--------------</td>
<td>----------</td>
<td>----------------</td>
<td>-----------------------</td>
<td>---------</td>
</tr>
<tr>
<td>1.</td>
<td>OHS352</td>
<td>Project Report Writing</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>OMA355</td>
<td>Advanced Numerical Methods</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>OMA356</td>
<td>Random Processes</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>OMA357</td>
<td>Queuing and Reliability Modelling</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>OMG354</td>
<td>Production and Operations Management for Entrepreneurs</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>OCE354</td>
<td>Basics of Integrated Water Resources Management</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>OMG355</td>
<td>Multivariate Data Analysis</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>OME352</td>
<td>Additive Manufacturing</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>OME343</td>
<td>New Product Development</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>OME355</td>
<td>Industrial Design &amp; Rapid Prototyping Techniques</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>MF3010</td>
<td>Micro and Precision Engineering</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>OMF354</td>
<td>Cost Management of Engineering Projects</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>13.</td>
<td>AU3002</td>
<td>Batteries and Management System</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>14.</td>
<td>AU3008</td>
<td>Sensors and Actuators</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>15.</td>
<td>OAS353</td>
<td>Space Vehicles</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>16.</td>
<td>OIM352</td>
<td>Management Science</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>17.</td>
<td>OIM353</td>
<td>Production Planning and Control</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>18.</td>
<td>OIE353</td>
<td>Operations Management</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>19.</td>
<td>OSF352</td>
<td>Industrial Hygiene</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>20.</td>
<td>OSF353</td>
<td>Chemical Process Safety</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>21.</td>
<td>OML352</td>
<td>Electrical, Electronic and Magnetic materials</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>22.</td>
<td>OML353</td>
<td>Nanomaterials and applications</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>23.</td>
<td>OMR352</td>
<td>Hydraulics and Pneumatics</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>24.</td>
<td>OMR353</td>
<td>Sensors</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>25.</td>
<td>ORA352</td>
<td>Concepts in Mobile Robots</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>26.</td>
<td>MV3501</td>
<td>Marine Propulsion</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>27.</td>
<td>OMV351</td>
<td>Marine Merchant Vessels</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>28.</td>
<td>OMV352</td>
<td>Elements of Marine Engineering</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>29.</td>
<td>CRA332</td>
<td>Drone Technologies</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>30.</td>
<td>OGI352</td>
<td>Geographical Information System</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>31.</td>
<td>OA1352</td>
<td>Agriculture Entrepreneurship Development</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>32.</td>
<td>OEN352</td>
<td>Biodiversity Conservation</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>33.</td>
<td>OEE353</td>
<td>Introduction to control systems</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>34.</td>
<td>OEI354</td>
<td>Introduction to Industrial</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Department</td>
<td>Credits</td>
<td>Hours</td>
<td>Additional Credits</td>
<td></td>
</tr>
<tr>
<td>-------------</td>
<td>-------------------------------------------------------</td>
<td>------------</td>
<td>---------</td>
<td>-------</td>
<td>--------------------</td>
<td></td>
</tr>
<tr>
<td>OCH353</td>
<td>Energy Technology</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OCH354</td>
<td>Surface Science</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OFD354</td>
<td>Fundamentals of Food Engineering</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OFD355</td>
<td>Food safety and Quality Regulations</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OPY353</td>
<td>Nutraceuticals</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OTT354</td>
<td>Basics of Dyeing and Printing</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>FT3201</td>
<td>Fibre Science</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OTT355</td>
<td>Garment Manufacturing Technology</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OPE353</td>
<td>Industrial Safety</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OPE354</td>
<td>Unit Operations in Petro Chemical Industries</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OPT352</td>
<td>Plastic Materials for Engineers</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OPT353</td>
<td>Properties and Testing of Plastics</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OEC353</td>
<td>VLSI Design</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CBM353</td>
<td>Wearable devices</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CBM354</td>
<td>Medical Informatics</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OBT355</td>
<td>Biotechnology for Waste Management</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OBT356</td>
<td>Lifestyle Diseases</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>OBT357</td>
<td>Biotechnology in Health Care</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>S.No</td>
<td>Subject Area</td>
<td>Credits per Semester</td>
<td>Total Credits</td>
<td></td>
<td></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>I  II  III  IV  V  VI  VII / VIII  VII/VIII</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>HSMC</td>
<td>5  5</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>BSC</td>
<td>12 7 4 2</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>ESC</td>
<td>5  11</td>
<td>16</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>PCC</td>
<td>20 20 8 6 7</td>
<td>61</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>PEC</td>
<td>12 12</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>OEC</td>
<td>3  9</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>EEC</td>
<td>1</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Non-Credit / (Mandatory)</td>
<td>√  √</td>
<td>11</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>22  23  25  22  20  22  22  10</td>
<td>166</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ENROLLMENT FOR B.E. / B. TECH. (HONOURS) / MINOR DEGREE (OPTIONAL)

A student can also optionally register for additional courses (18 credits) and become eligible for the award of B.E. / B. Tech. (Honours) or Minor Degree.

For B.E. / B. Tech. (Honours), a student shall register for the additional courses (18 credits) from semester V onwards. These courses shall be from the same vertical or a combination of different verticals of the same programme of study only.

For minor degree, a student shall register for the additional courses (18 credits) from semester V onwards. All these courses have to be in a particular vertical from any one of the other programmes. Moreover, for minor degree the student can register for courses from any one of the following verticals also.

Complete details are available in clause 4.10 (Amendments) of Regulations 2021.

VERTICALS FOR MINOR DEGREE (In addition to the all the verticals of other programmes)

<table>
<thead>
<tr>
<th>Vertical I Fintech and Block Chain</th>
<th>Vertical II Entrepreneurship</th>
<th>Vertical III Public Administration</th>
<th>Vertical IV Business Data Analytics</th>
<th>Vertical V Environment and Sustainability</th>
</tr>
</thead>
</table>

19
<table>
<thead>
<tr>
<th>Vertical Name</th>
<th>Course Title</th>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Category</th>
<th>Periods Per Week</th>
<th>Total Contact Periods</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Financial Management</strong></td>
<td>Foundations of Entrepreneurship</td>
<td>1</td>
<td>CMG331</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Fundamentals of Investment</strong></td>
<td>Team Building &amp; Leadership Management for Business</td>
<td>2</td>
<td>CMG332</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Banking, Financial Services and Insurance</strong></td>
<td>Constitution of India</td>
<td>3</td>
<td>CMG333</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Introduction to Blockchain and its Applications</strong></td>
<td>Administrative Theories</td>
<td>4</td>
<td>CMG334</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>Fintech Personal Finance and Payments</strong></td>
<td>Indian Administrative System</td>
<td>5</td>
<td>CMG335</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

(Choice of courses for Minor degree is to be made from any one vertical of other programmes or from anyone of the following verticals)

**VERTICAL 1: FINTECH AND BLOCK CHAIN**
<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>CMG337</td>
<td>Foundations of Entrepreneurship</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CMG338</td>
<td>Team Building &amp; Leadership Management for Business</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CMG339</td>
<td>Creativity &amp; Innovation in Entrepreneurship</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CMG340</td>
<td>Principles of Marketing Management For Business</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CMG341</td>
<td>Human Resource Management for Entrepreneurs</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>CMG342</td>
<td>Financing New Business Ventures</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
### VERTICAL 3: PUBLIC ADMINISTRATION

<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>CMG343</td>
<td>Principles of Public Administration</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CMG344</td>
<td>Constitution of India</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CMG345</td>
<td>Public Personnel Administration</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CMG346</td>
<td>Administrative Theories</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CMG347</td>
<td>Indian Administrative System</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>CMG348</td>
<td>Public Policy Administration</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

### VERTICAL 4: BUSINESS DATA ANALYTICS

<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>CMG349</td>
<td>Statistics For Management</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CMG350</td>
<td>Data mining For Business Intelligence</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CMG351</td>
<td>Human Resource Analytics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CMG352</td>
<td>Marketing And Social Media Web Analytics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CMG353</td>
<td>Operation nd Supply Chain Analytics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>CMG354</td>
<td>Financial Analytics</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>CATEGORY</td>
<td>PERIODS PER WEEK</td>
<td>TOTAL CONTACT PERIODS</td>
<td>CREDITS</td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
<td>-----------------------------------------------------------</td>
<td>----------</td>
<td>------------------</td>
<td>-----------------------</td>
<td>---------</td>
</tr>
<tr>
<td>1.</td>
<td>CES331</td>
<td>Sustainable infrastructure Development</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>CES332</td>
<td>Sustainable Agriculture and Environmental Management</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CES333</td>
<td>Sustainable Bio Materials</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CES334</td>
<td>Materials for Energy Sustainability</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CES335</td>
<td>Green Technology</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>CES336</td>
<td>Environmental Quality Monitoring and Analysis</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>CES337</td>
<td>Integrated Energy Planning for Sustainable Development</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>CES338</td>
<td>Energy Efficiency for Sustainable Development</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:

"Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed."

"One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character."

Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it everyday for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing.
Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering/Technology/Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

**Induction Programme is totally an activity based programme and therefore there shall be no tests / assessments during this programme.**

References:
Guide to Induction program from AICTE
OBJECTIVES:
- To improve the communicative competence of learners
- To learn to use basic grammatical structures in suitable contexts
- To acquire lexical competence and use them appropriately in a sentence and understand their meaning in a text
- To help learners use language effectively in professional contexts
- To develop learners’ ability to read and write complex texts, summaries, articles, blogs, definitions, essays and user manuals.

UNIT I
INTRODUCTION TO EFFECTIVE COMMUNICATION
What is effective communication? (Explain using activities) Why is communication critical for excellence during study, research and work? What are the seven C’s of effective communication? What are key language skills? What is effective listening? What does it involve? What is effective speaking? What does it mean to be an excellent reader? What should you be able to do? What is effective writing? How does one develop language and communication skills? What does the course focus on? How are communication and language skills going to be enhanced during this course? What do you as a learner need to do to enhance your English language and communication skills to get the best out of this course?

INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION
Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails. Writing - Writing emails / letters introducing oneself. Grammar - Present Tense (simple and progressive); Question types: Why/ Yes or No/ and Tags. Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

UNIT II
NARRATION AND SUMMATION
Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs. Writing - Guided writing-- Paragraph writing Short Report on an event (field trip etc.) Grammar --Past tense (simple); Subject-Verb Agreement; and Prepositions. Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.

UNIT III
DESCRIPTION OF A PROCESS / PRODUCT
Reading – Reading advertisements, gadget reviews; user manuals. Writing - Writing definitions; instructions; and Product /Process description. Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect Tenses. Vocabulary - Compound Nouns, Homonyms, and Homophones, discourse markers (connectives & sequence words).

UNIT IV
CLASSIFICATION AND RECOMMENDATIONS
Reading – Newspaper articles; Journal reports –and Non Verbal Communication (tables, pie charts etc.). Writing – Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non verbal (chart, graph etc, to verbal mode) Grammar – Articles; Pronouns - Possessive & Relative pronouns. Vocabulary - Collocations; Fixed / Semi fixed expressions.
UNIT V EXPRESSION
Reading – Reading editorials; and Opinion Blogs; Writing – Essay Writing (Descriptive or narrative). Grammar – Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences. Vocabulary - Cause & Effect Expressions – Content vs Function words.

TOTAL : 45 PERIODS

LEARNING OUTCOMES:
At the end of the course, learners will be able
- To use appropriate words in a professional context
- To gain understanding of basic grammatic structures and use them in right context.
- To read and infer the denotative and connotative meanings of technical texts
- To write definitions, descriptions, narrations and essays on various topics

TEXT BOOKS:
1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition)
2. English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCE BOOKS:

ASSESSMENT PATTERN
Two internal assessments and an end semester examination to test students’ reading and writing skills along with their grammatical and lexical competence.

CO-PO & PSO MAPPING

<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>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AVg.</td>
<td>1.6</td>
<td>2.2</td>
<td>1.8</td>
<td>2.2</td>
<td>1.5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1.6</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

- 1-low, 2-medium, 3-high, "-" no correlation
- Note: The average value of this course to be used for program articulation matrix.
COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

UNIT - I MATRICES 9 + 3

UNIT - II DIFFERENTIAL CALCULUS 9 + 3

UNIT - III FUNCTIONS OF SEVERAL VARIABLES 9 + 3

UNIT - IV INTEGRAL CALCULUS 9 + 3
Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications: Hydrostatic force and pressure, moments and centres of mass.

UNIT - V MULTIPLE INTEGRALS 9 + 3

COURSE OUTCOMES:
At the end of the course the students will be able to

- Use the matrix algebra methods for solving practical problems.
- Apply differential calculus tools in solving various application problems.
- Able to use differential calculus ideas on several variable functions.
- Apply different methods of integration in solving practical problems.
- Apply multiple integral ideas in solving areas, volumes and other practical problems.

TEXT BOOKS:
3. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

REFERENCES:

<table>
<thead>
<tr>
<th>PO</th>
<th>PO</th>
<th>PO</th>
<th>PO</th>
<th>PO</th>
<th>PO</th>
<th>PO</th>
<th>PO</th>
<th>PO</th>
<th>PO</th>
<th>PO</th>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>C01</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>C02</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>C03</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>C04</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>C05</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>Avg</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>-</td>
</tr>
</tbody>
</table>

PH3151 ENGINEERING PHYSICS L T P C 3 0 0 3

COURSE OBJECTIVES
- To make the students effectively to achieve an understanding of mechanics.
- To enable the students to gain knowledge of electromagnetic waves and its applications.
- To introduce the basics of oscillations, optics and lasers.
- Equipping the students to be successfully understand the importance of quantum physics.
- To motivate the students towards the applications of quantum mechanics.

UNIT I MECHANICS
UNIT II ELECTROMAGNETIC WAVES
The Maxwell’s equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium-vacuum interface for normal incidence.

UNIT III OSCILLATIONS, OPTICS AND LASERS

UNIT IV BASIC QUANTUM MECHANICS
Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in a infinite potential well: 1D, 2D and 3D Boxes- Normalization, probabilities and the correspondence principle.

UNIT V APPLIED QUANTUM MECHANICS
The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch’s theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.

TOTAL : 45 PERIODS

COURSE OUTCOMES
After completion of this course, the students should be able to
- Understand the importance of mechanics.
- Express their knowledge in electromagnetic waves.
- Demonstrate a strong foundational knowledge in oscillations, optics and lasers.
- Understand the importance of quantum physics.
- Comprehend and apply quantum mechanical principles towards the formation of energy bands.

TEXT BOOKS:
2. E.M.Purcell and D.J.Morin, Electricity and Magnetism, Cambridge Univ.Press, 2013.

REFERENCES:

CO’s-PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>AVG</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

6.  1-Low, 2-Medium, 3-High,”-“-no correlation
7.  Note: the average value of this course to be used for program articulation matrix.

CY3151 ENGINEERING CHEMISTRY  L T P C
3 0 0 3

COURSE OBJECTIVES:
- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I WATER AND ITS TREATMENT

UNIT II NANO CHEMISTRY
Basics: Distinction between molecules, nanomaterials and bulk materials; Size-dependent properties (optical, electrical, mechanical and magnetic); Types of nanomaterials: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. Preparation of nanomaterials: sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. Applications of nanomaterials in medicine, agriculture, energy, electronics and catalysis.
UNIT III  PHASE RULE AND COMPOSITES  9
Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process.
Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.

UNIT IV  FUELS AND COMBUSTION  9
Fuels: Introduction: Classification of fuels; Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; Power alcohol and biodiesel.
Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO₂ emission and carbon foot print.

UNIT V  ENERGY SOURCES AND STORAGE DEVICES  9
Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; Electric vehicles – working principles; Fuel cells: H₂-O₂ fuel cell, microbial fuel cell; Supercapacitors: Storage principle, types and examples.

COURSE OUTCOMES
At the end of the course, the students will be able:
• To infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.
• To identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.
• To apply the knowledge of phase rule and composites for material selection requirements.
• To recommend suitable fuels for engineering processes and applications.
• To recognize different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

REFERENCES:

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
<th>Avg.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1.3</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>-</td>
<td>1.6</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1.1</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>1</td>
<td>1.8</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Avg.</td>
<td>2.8</td>
<td>1.3</td>
<td>1.6</td>
</tr>
</tbody>
</table>

1-low, 2-medium, 3-high, ‘-’- no correlation

GE3151  PROBLEM SOLVING AND PYTHON PROGRAMMING  L T P C
3 0 0 3

COURSE OBJECTIVES:
- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To do input/output with files in Python.

UNIT I  COMPUTATIONAL THINKING AND PROBLEM SOLVING  9

UNIT II  DATA TYPES, EXPRESSIONS, STATEMENTS  9
Python interpreter and interactive mode,debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III  CONTROL FLOW, FUNCTIONS, STRINGS  9
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.
UNIT IV LISTS, TUPLES, DICTIONARIES
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT V FILES, MODULES, PACKAGES
Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter’s age validation, Marks range validation (0-100).

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, students will be able to
CO1: Develop algorithmic solutions to simple computational problems.
CO2: Develop and execute simple Python programs.
CO3: Write simple Python programs using conditionals and looping for solving problems.
CO4: Decompose a Python program into functions.
CO5: Represent compound data using Python lists, tuples, dictionaries etc.
CO6: Read and write data from/to files in Python programs.

TEXT BOOKS:

REFERENCES:
5. https://www.python.org/

COs- PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Avg.</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

1 - low, 2 - medium, 3 - high, ‘-’ - no correlation
அத்தி I  இந்திய அலகு அறக்கொட்பொடு
அதிபரத்திறன் - சிற்பங்கள் விளக்கம் - கதை ஒன்று தொக்கம்  - கதைச் சொல்லுதல் தொடர்புப் பங்குகுடியினர் - தமிழ் தமிழன் அரசு - தேசிய கருடையல் கல்வியியல் - தமிழக உரையளர்ப்புக் கல்வி - பொழுது தொலைபேச்சு, நூலியம் வளங்கள் வரலொறுகள் - தமிழக கோலகிளை வண்ணக்கட்டம் - தமிழும் தேசிய தானியங்கள் பாருதம் முதல் பார்க்களால் தமிழக விளக்கம் பார்க்கல்.

அத்தி II  மொழி - பாதுகாப்பு கோலகிளை வண்ணச் செயலியங்கள் மற்றும் தமிழ் தொன்மைக்கள் வண்ணம் - கூறுகள்
முதல் மேற்பரப்பு தவளியீடு - தமிழாசன் தொடர்பு - பண்பாடுகள் பண்பாடு மேற்பரப்பு குறிப்பிட்டுக் கொள்ளும் கருத்திருப்பது, வங்கால்பார்பு - கதை ஏற்ற அலகு - உயர்ந்த சிற்பங்கள் - தானியாகிவிடும் கருத்திருப்பது எப்படி - தவளியீடு கருத்திருப்பது - பொருளோர், பாதுகாப்பு, நூல்பொட்டம், நூல் பற்றியவை - தமிழக விளக்கம் வளங்கள் வரலொறுகள் விளக்கம், பார்க்கல்.

அத்தி III  வரலொறுகள் கல்விகள் மற்றும் சிற்பங்கள்: 3
தமிழ்க் கல்வி, கல்விச் சேவை, கல்விப் பொருள், கல்விப் பண்டை, கல்வியுடைய கற்று, சிற்பங்கள், மற்றும் தமிழ் விளக்கம், பார்க்கல்.

அத்தி IV  தமிழக விளக்கம் வரலொறுகள்: 3
தமிழக விளக்கம் திட்டக்குரியது, சிற்பங்கள் - கோலகிளையை மேற்பரப்பு கருத்திருப்பது அனைத்து பொருள் போன்ற பொருள்கள் - தமிழக விளக்கம் வரலொறுகளை குறிப்பிட்டுக் கொள்ள தொடர்கள் - தமிழக விளக்கம் குறிப்பிட்டுக் கொள்ள தொடர்களை குறிப்பிட்டுக் கொள்ள தொடர்களை குறிப்பிட்டுக் கொள்ள தொடர்களை குறிப்பிட்டுக் கொள்ள.

அத்தி V  தமிழ் விளக்க வரலொறுகள் மற்றும் தமிழ் விளக்கப்பாடுகள்: 3
தமிழ் விளக்க வரலொறுகள் மற்றும் தமிழ் விளக்கப்பாடுகளை குறிப்பிட்டுக் கொள்ள - தமிழகவின் பட்டியலியங்கள் வரலொறுகளை குறிப்பிட்டுக் கொள்ள - தமிழகவின் பட்டியலியங்கள் வரலொறுகளை குறிப்பிட்டுக் கொள்ள - தமிழகவின் பட்டியலியங்களை குறிப்பிட்டுக் கொள்ள - கல்வியுடைய வரலொறுகளை குறிப்பிட்டுக் கொள்ள - தமிழ் புத்தகங்களை குறிப்பிட்டு கொள்ள.

TEXT-CUM-REFERENCE BOOKS
1. தமிழ் விளக்கம் - புதுகை புத்தகங்கள் - ச.ச.செ. பொருள் (தமிழில்: தியாந்து புதுகை புத்தகங்கள் குறிப்பிட்டு கொள்ள).
2. தமிழ் விளக்கம் - புதுகை புத்தகங்கள் தமிழ் (தியாந்து பொருள்).
3. தமிழ் விளக்கம் - புதுகை புத்தகங்கள் குறிப்பிட்டு வரலொறுகள் (தியாந்து பொருள்)

TOTAL : 15 PERIODS
4. பாணக்கூட – அகரமைக்கத் தாக்குதல். (தங்கொண்டிகள் குறுக்கு பலிக்கிச்)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

GE3152 HERITAGE OF TAMILS L T P C 1 0 0 1

UNIT I LANGUAGE AND LITERATURE

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE
Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvaluvur Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III FOLK AND MARTIAL ARTS
Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Games and Sports of Tamils.

UNIT IV THINAI CONCEPT OF TAMILS
Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE
Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.
TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலை - மக்களும் பண் பொடும் - தலைசிதார். பிளமளி (தவளியீடு: தமிழ்நொடு பார்வைய மற்றும் தவளியீடு வடிவில் குறிப்பிட்டு).
2. கணினித் தமிழ் - முமனவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி - வாகன நிறுவக சிற்றுற்று தகவலிடுதல் (தவளியீடு துமறதவளியீடு).
4. பொருமநாடு - முமனவர் தகவலிடுதல். (தவளியீடு துமறதவளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)

GE3171 PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY L T P C 0 0 4 2

COURSE OBJECTIVES:
- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

EXPERIMENTS:
Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building – operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy, Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter’s age validity, student mark range validation)
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
On completion of the course, students will be able to:
CO1: Develop algorithmic solutions to simple computational problems
CO2: Develop and execute simple Python programs.
CO3: Implement programs in Python using conditionals and loops for solving problems.
CO4: Deploy functions to decompose a Python program.
CO5: Process compound data using Python data structures.
CO6: Utilize Python packages in developing software applications.

TEXT BOOKS:

REFERENCES:
5. https://www.python.org/

COs- PO’s & PSO’s MAPPING

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

AVg. 2 3 3 3 2 - - - - 2 2 3
PHYSICS LABORATORY: (Any Seven Experiments)

COURSE OBJECTIVES:
- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To learn problem solving skills related to physics principles and interpretation of experimental data.
- To determine error in experimental measurements and techniques used to minimize such error.
- To make the student an active participant in each part of all lab exercises.

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. Non-uniform bending - Determination of Young’s modulus
4. Uniform bending – Determination of Young’s modulus
5. Laser- Determination of the wave length of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle  
   b) Compact disc- Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer - determination of the velocity of sound and compressibility of liquids
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde’s string experiment
14. Experiment with lattice dynamics kit.

TOTAL: 30 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students should be able to
- Understand the functioning of various physics laboratory equipment.
- Use graphical models to analyze laboratory data.
- Use mathematical models as a medium for quantitative reasoning and describing physical reality.
- Access, process and analyze scientific information.
- Solve problems individually and collaboratively.

CO’s-PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</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>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</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>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</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>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</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>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</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>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>AVG</td>
<td>3</td>
<td>2.4</td>
<td>2.6</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

- 1-Low,2-Medium,3-High,”-.“-no correlation
- Note: the average value of this course to be used for program articulation matrix.

39
CHEMISTRY LABORATORY: (Any seven experiments to be conducted)

COURSE OBJECTIVES:
- To inculcate experimental skills to test basic understanding of water quality parameters, such as, acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electroanalytical techniques such as, pHmetry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and alloys.
- To demonstrate the synthesis of nanoparticles
  1. Preparation of Na₂CO₃ as a primary standard and estimation of acidity of a water sample using the primary standard
  2. Determination of types and amount of alkalinity in water sample.
     - Split the first experiment into two
  3. Determination of total, temporary & permanent hardness of water by EDTA method.
  4. Determination of DO content of water sample by Winkler’s method.
  5. Determination of chloride content of water sample by Argentometric method.
  6. Estimation of copper content of the given solution by Iodometry.
  7. Estimation of TDS of a water sample by gravimetry.
  8. Determination of strength of hydrochloric acid using pH meter.
  9. Determination of strength of acids in a mixture of acids using conductivity meter.
 10. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)
 11. Estimation of iron content of the given solution using potentiometer.
 13. Preparation of nanoparticles (TiO₂/ZnO/CuO) by Sol-Gel method.
 14. Estimation of Nickel in steel
 15. Proximate analysis of Coal

TOTAL : 30 PERIODS

COURSE OUTCOMES:
- To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
- To determine the amount of metal ions through volumetric and spectroscopic techniques
- To analyse and determine the composition of alloys.
- To learn simple method of synthesis of nanoparticles
- To quantitatively analyse the impurities in solution by electroanalytical techniques

TEXT BOOK:

CO-PO & PSO MAPPING

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Avg.</td>
<td>2.6</td>
<td>1.3</td>
</tr>
</tbody>
</table>

1-low, 2-medium, 3-high, ‘-‘- no correlation
OBJECTIVES:
- To improve the communicative competence of learners
- To help learners use language effectively in academic/work contexts
- To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
- To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
- To use language efficiently in expressing their opinions via various media.

UNIT I  INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION  6
Listening for general information-specific details- conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form. Speaking - making telephone calls-Self Introduction; Introducing a friend; - politeness strategies- making polite requests, making polite offers, replying to polite requests and offers- understanding basic instructions( filling out a bank application for example).

UNIT II  NARRATION AND SUMMATION  6
Listening - Listening to podcasts, anecdotes / stories / event narration; documentaries and interviews with celebrities. Speaking - Narrating personal experiences / events-Talking about current and temporary situations & permanent and regular situations* - describing experiences and feelings- engaging in small talk- describing requirements and abilities.

UNIT III  DESCRIPTION OF A PROCESS / PRODUCT  6
Listening - Listen to product and process descriptions; a classroom lecture; and advertisements about products. Speaking – Picture description-describing locations in workplaces- Giving instruction to use the product- explaining uses and purposes- Presenting a product- describing shapes and sizes and weights- talking about quantities(large & small)- talking about precautions.

UNIT IV  CLASSIFICATION AND RECOMMENDATIONS  6
Listening – Listening to TED Talks; Listening to lectures - and educational videos. Speaking – Small Talk; discussing and making plans-talking about tasks-talking about progress-talking about positions and directions of movement-talking about travel preparations- talking about transportation-

UNIT V  EXPRESSION  6
Listening – Listening to debates/ discussions; different viewpoints on an issue; and panel discussions. Speaking –making predictions- talking about a given topic-giving opinions-understanding a website-describing processes

LEARNING OUTCOMES:
At the end of the course, learners will be able
- To listen and comprehend complex academic texts
- To speak fluently and accurately in formal and informal communicative contexts
- To express their opinions effectively in both oral and written medium of communication

TOTAL : 30 PERIODS
ASSESSMENT PATTERN

- One online/app based assessment to test listening/speaking
- End Semester ONLY listening and speaking will be conducted online.
- Proficiency certification is given on successful completion of listening and speaking internal test and end semester exam.

CO-PO & PSO MAPPING

<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>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Avg.</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1-low, 2-medium, 3-high, '-'-no correlation
Note: The average value of this course to be used for program articulation matrix.

HS3252  PROFESSIONAL ENGLISH - II  L T P C

2 0 0  2

OBJECTIVES:

- To engage learners in meaningful language activities to improve their reading and writing skills
- To learn various reading strategies and apply in comprehending documents in professional context.
- To help learners understand the purpose, audience, contexts of different types of writing
- To develop analytical thinking skills for problem solving in communicative contexts
- To demonstrate an understanding of job applications and interviews for internship and placements

UNIT I  MAKING COMPARISONS
Reading - Reading advertisements, user manuals, brochures; Writing – Professional emails, Email etiquette - Compare and Contrast Essay;
Grammar – Mixed Tenses, Prepositional phrases

UNIT II  EXPRESSING CAUSAL RELATIONS IN SPEAKING AND WRITING
Reading - Reading longer technical texts-Cause and Effect Essays, and Letters / emails of complaint, Writing - Writing responses to complaints. Grammar - Active Passive Voice transformations, Infinitive and Gerunds

UNIT III  PROBLEM SOLVING
Reading - Case Studies, excerpts from literary texts, news reports etc. Writing – Letter to the Editor, Checklists, Problem solution essay / Argumentative Essay. Grammar – Error correction; If conditional sentences

UNIT IV  REPORTING OF EVENTS AND RESEARCH
UNIT V THE ABILITY TO PUT IDEAS OR INFORMATION COGENTLY  6
Reading – Company profiles, Statement of Purpose, (SOP), an excerpt of interview with professionals; Writing – Job / Internship application – Cover letter & Resume; Grammar – Numerical adjectives, Relative Clauses.

TOTAL : 30 PERIODS

OUTCOMES:
At the end of the course, learners will be able
- To compare and contrast products and ideas in technical texts.
- To identify cause and effects in events, industrial processes through technical texts
- To analyse problems in order to arrive at feasible solutions and communicate them orally and in the written format.
- To report events and the processes of technical and industrial nature.
- To present their opinions in a planned and logical manner, and draft effective resumes in context of job search.

TEXT BOOKS :
3. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCES:

ASSESSMENT PATTERN
Two internal assessments and an end semester examination to test students’ reading and writing skills along with their grammatical and lexical competence.

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AVg.</td>
<td>3</td>
<td>3.25</td>
</tr>
</tbody>
</table>

1-low, 2-medium, 3-high, ‘-‘- no correlation

Note: The average value of this course to be used for program articulation matrix.
MA3251  STATISTICS AND NUMERICAL METHODS  L  T  P  C
            3  1  0  4

COURSE OBJECTIVES:
• This course aims at providing the necessary basic concepts of a few statistical and
  numerical methods and give procedures for solving numerically different kinds of
  problems occurring in engineering and technology.
• To acquaint the knowledge of testing of hypothesis for small and large samples
  which plays an important role in real life problems.
• To introduce the basic concepts of solving algebraic and transcendental equations.
• To introduce the numerical techniques of interpolation in various intervals and
  numerical techniques of differentiation and integration which plays an important role
  in engineering and technology disciplines.
• To acquaint the knowledge of various techniques and methods of solving ordinary
  differential equations.

UNIT I  TESTING OF HYPOTHESIS  9+3
Sampling distributions - Tests for single mean, proportion and difference of means (Large
and small samples) – Tests for single variance and equality of variances – Chi square test
for goodness of fit – Independence of attributes.

UNIT II  DESIGN OF EXPERIMENTS  9+3
One way and two way classifications - Completely randomized design – Randomized block
design – Latin square design - 2^2 factorial design.

UNIT III  SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS  9+3
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton
Raphson method- Solution of linear system of equations - Gauss elimination method –
Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel -
Eigenvalues of a matrix by Power method and Jacobi’s method for symmetric matrices.

UNIT IV  INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL
INTEGRATION  9+3
Lagrange’s and Newton’s divided difference interpolations – Newton’s forward and backward
difference interpolation – Approximation of derivates using interpolation polynomials –
Numerical single and double integrations using Trapezoidal and Simpson’s 1/3 rules.

UNIT V  NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS  9+3
Single step methods: Taylor’s series method - Euler’s method - Modified Euler’s method -
Fourth order Runge-Kutta method for solving first order differential equations - Multi step
methods: Milne’s and Adams - Bash forth predictor corrector methods for solving first order
differential equations.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, students will be able to:
• Apply the concept of testing of hypothesis for small and large samples in real life
  problems.
• Apply the basic concepts of classifications of design of experiments in the field of
  agriculture.
• Appreciate the numerical techniques of interpolation in various intervals and apply the
  numerical techniques of differentiation and integration for engineering problems.
• Understand the knowledge of various techniques and methods for solving first and
  second order ordinary differential equations.
• Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

**TEXT BOOKS:**

**REFERENCES:**

<table>
<thead>
<tr>
<th></th>
<th>PO 01</th>
<th>PO 02</th>
<th>PO 03</th>
<th>PO 04</th>
<th>PO 05</th>
<th>PO 06</th>
<th>PO 07</th>
<th>PO 08</th>
<th>PO 09</th>
<th>PO 10</th>
<th>PO 11</th>
<th>PO 12</th>
<th>PS O1</th>
<th>PS O2</th>
<th>PS O3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Avg</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

PH3251 MATERIALS SCIENCE  L T P C
3 0 0 3

**COURSE OBJECTIVES:**
• To make the students to understand the basics of crystallography and its importance in studying materials properties.
• To understand the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials.
• To instil knowledge on physics of semiconductors, determination of charge carriers and device applications
• To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications
• To inculcate an idea of significance of nano structures, quantum confinement and ensuing nano device applications.

45
UNIT I CRYSTALLOGRAPHY

UNIT II ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS

UNIT III SEMICONDUCTORS AND TRANSPORT PHYSICS

UNIT IV OPTICAL PROPERTIES OF MATERIALS

UNIT V NANO ELECTRONIC DEVICES

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the students should be able to
- know basics of crystallography and its importance for varied materials properties
- gain knowledge on the electrical and magnetic properties of materials and their applications
- understand clearly of semiconductor physics and functioning of semiconductor devices
- understand the optical properties of materials and working principles of various optical devices
- appreciate the importance of functional nanoelectronic devices.

TEXT BOOKS:

REFERENCES:

<table>
<thead>
<tr>
<th>CO’s-PO’s &amp; PSO’s MAPPING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CO’s</strong></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>AVG</td>
</tr>
</tbody>
</table>

1-Low, 2-Medium, 3-High, “-”-no correlation
Note: the average value of this course to be used for program articulation matrix.

BE3251 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING L T P C

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

COURSE OBJECTIVES:
- To introduce the basics of electric circuits and analysis
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce analog devices and their characteristics
- To educate on the fundamental concepts of digital electronics
- To introduce the functional elements and working of measuring instruments

UNIT I ELECTRICAL CIRCUITS 9
DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm’s Law - Kirchhoff’s Laws – Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state)
Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only)

UNIT II ELECTRICAL MACHINES 9
UNIT III  ANALOG ELECTRONICS  9
Resistor, Inductor and Capacitor in Electronic Circuits- Semiconducto

UNIT IV  DIGITAL ELECTRONICS  9
Review of number systems, binary codes, error detection and correction codes, Combinational logic - representation of logic functions-SOP and POS forms, K-map representations - minimization using K maps (Simple Problems only)

UNIT V  MEASUREMENTS AND INSTRUMENTATION  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completing this course, the students will be able to
1. Compute the electric circuit parameters for simple problems
2. Explain the working principle and applications of electrical machines
3. Analyze the characteristics of analog electronic devices
4. Explain the basic concepts of digital electronics
5. Explain the operating principles of measuring instruments

TEXT BOOKS:

REFERENCES:

<table>
<thead>
<tr>
<th>COs/POs&amp;P SOs</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PSOs</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Mapping of COs with POs and PSOs
GE3251 ENGINEERING GRAPHICS

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Drawing engineering curves.
2. Drawing freehand sketch of simple objects.
3. Drawing orthographic projection of solids and section of solids.
4. Drawing development of solids
5. Drawing isometric and perspective projections of simple solids.

CONCEPTS AND CONVENTIONS (Not for Examination)
Importance of graphics in engineering applications - Use of drafting instruments - BIS conventions and specifications — Size, layout and folding of drawing sheets — Lettering and dimensioning.

UNIT I PLANE CURVES 6+12
Basic Geometrical constructions, Curves used in engineering practices: Conics — Construction of ellipse, parabola and hyperbola by eccentricity method — Construction of cycloid — construction of involutes of square and circle — Drawing of tangents and normal to the above curves.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12
Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS AND FREEHAND SKETCHING 6+12
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method. Visualization concepts and Free Hand sketching: Visualization principles — Representation of Three Dimensional objects — Layout of views- Freehand sketching of multiple views from pictorial views of objects.
Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6 +12
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other — obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids — Prisms, pyramids cylinders and cones.
Practicing three dimensional modeling of simple objects by CAD Software (Not for examination)
UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+12

Principles of isometric projection — isometric scale - Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions - Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

Practicing three dimensional modeling of isometric projection of simple objects by CAD Software (Not for examination)

TOTAL: (L=30; P=60) 90 PERIODS

COURSE OUTCOMES:
On successful completion of this course, the student will be able to
• Use BIS conventions and specifications for engineering drawing.
• Construct the conic curves, involutes and cycloid.
• Solve practical problems involving projection of lines.
• Draw the orthographic, isometric and perspective projections of simple solids.
• Draw the development of simple solids.

TEXT BOOKS:

REFERENCES:

Publication of Bureau of Indian Standards:

Special points applicable to University Examinations on Engineering Graphics:
1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

<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>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Low (1) ; Medium (2) ; High (3)

GE3252  தமிழ் மதொழில்நுட்பம் 1 0 0 1

அலகு I  மகளா ஐமனும் பாரசீக அரசிசுருள்ளை:
3
தமிழ் கால்விளை சியற்றுத் தனியை - பாரசீக விளைப்புவரை - கண்கை திரும்பி பாரசீகத்திற்கான கிருப்பிளை.

அலகு II  அவர்களும் மூச்சை கால்விளைப்பு:
3
தமிழ் கால்விளை வடிவமைப்பு மற்றும் கண்கை உண்மைத்தியங்கள் & கண்கை கால்விளை நூற்றூர் வழியிலிங் வழியில் வடிவமைப் படிவங்களில் - கண்கை கால்விளை வடிவமைப்பு திண்குவதில் - சிவப்புக்கால்விளை தமிழில் ஏற்று குறிப்பிட்டு வழிகாட்டும், இரண்டுடன் - முனையவுக்கால்விளை பயின்றூட்டுகக் குறிப்பிட்டு குறிக்கும் - முக்கியருக்கால்விளை - மற்றும் கூடும் வழியிலிங் பாட்டு அறிவு வழியில் உருவான சிண்மைகள், முனையவுக்கால்விளை வழியில் சிண்மைகள் கலந்துகொள்றுக்கான பல்வேறு கால்விளைகளில் உருவாகக் கொள்ளவும்.

அலகு III  கவளொைறா குழுவு:
3
கப்பல் கட்டும் கால்விளை - சிறுகுழுக்கள் - குறிப்பிட்டு பல்வேறு குழுவுகள், பலுக்கும் கால்விளைகள் வழியில் மென்மைகள் கால்விளை உண்மைத்தியங்கள் - மென்பொருள் அறிவுகள் - முக்கிய சிவப்புக்கால்விளைகளுக்குட்பட்ட முக்கியமான கிணறுகள் - தம்பரோர்கள், கலைநரால் மாநிலங்கள் - தம்பரோர்கள் - சிவப்புக்கால்விளைகள் - கற்று மாநிலங்கள் - தம்பரோர்கள் - குழுவுகளின் பல்வேறு குழுவுகள்.

அலகு IV  எருவாளர் சுழற்சி குழுப்பு கால்விளை நூற்றூர்:
3
ஆராட்டான, தொலைக்குடும்ப வாழ்க்கை - தமிழ் கால்விளை குழுவுகள் மேற்கில் குறிப்பிட்டு - கால்விளை மேற்கில் - கால்விளை மேற்கில் குறிப்பிட்டு விளைப்பட்டால் - எருவாளர் சுழற்சி குழுப்பில் எருவாளராக குறிப்பிட்டு - கால்விளை மேற்கில் - மேற்கில் மேற்கில் - பல்வேறு குழுவுகள் மேற்கில் மேற்கில் - எருவாளராக குறிப்பிட்டு.
TEXT-CUM-REFERENCE BOOKS

1. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
2. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
3. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
5. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
6. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

GE3252 TAMILS AND TECHNOLOGY

UNIT I WEAVING AND CERAMIC TECHNOLOGY
Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY
Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.
UNIT III MANUFACTURING TECHNOLOGY

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY
Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries - Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING
Development of Scientific Tamil - Tamil computing - Digitalization of Tamil Books - Development of Tamil Software - Tamil Virtual Academy - Tamil Digital Library - Online Tamil Dictionaries - Sorkuvai Project.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS
1. தமிழக வரலொறு – மக்களும் பண பொடும் – மக். மக். பிளமள (தவளியீடு: தமிழ்நொடுபொடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முமனவர் இல. சுந்தரம் (விகடன் பிரசுரம்).
3. கீழடி மவமக நதிக்கமரயில் எங்ககொல நகரநொகரிகம் (ததொல்லியல் துமறதவளியீடு)
4. பம்பியோ அற்றமல்மல் நகரிகம் (ததொல்லியல் துமறதவளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - ‘Sangam City Civilization on the banks of river Vaigai’ (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
### NCC CREDIT COURSE LEVEL 1*

**NX3251**  
(ARMY WING) NCC CREDIT COURSE LEVEL - I  
<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

#### NCC GENERAL
- **NCC 1** Aims, Objectives & Organization of NCC  
- **NCC 2** Incentives  
- **NCC 3** Duties of NCC Cadet  
- **NCC 4** NCC Camps: Types & Conduct

#### NATIONAL INTEGRATION AND AWARENESS
- **NI 1** National Integration: Importance & Necessity  
- **NI 2** Factors Affecting National Integration  
- **NI 3** Unity in Diversity & Role of NCC in Nation Building  
- **NI 4** Threats to National Security

#### PERSONALITY DEVELOPMENT
- **PD 1** Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and Problem Solving  
- **PD 2** Communication Skills  
- **PD 3** Group Discussion: Stress & Emotions

#### LEADERSHIP
- **L 1** Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code  
- **L 2** Case Studies: Shivaji, Jhasi Ki Rani

#### SOCIAL SERVICE AND COMMUNITY DEVELOPMENT
- **SS 1** Basics, Rural Development Programmes, NGOs, Contribution of Youth  
- **SS 4** Protection of Children and Women Safety  
- **SS 5** Road / Rail Travel Safety  
- **SS 6** New Initiatives  
- **SS 7** Cyber and Mobile Security Awareness

**TOTAL: 30 PERIODS**
### NX3252

**NAVAL WING** NCC CREDIT COURSE LEVEL - I

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

#### NCC GENERAL

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCC 1</td>
<td>Aims, Objectives &amp; Organization of NCC</td>
</tr>
<tr>
<td>NCC 2</td>
<td>Incentives</td>
</tr>
<tr>
<td>NCC 3</td>
<td>Duties of NCC Cadet</td>
</tr>
<tr>
<td>NCC 4</td>
<td>NCC Camps: Types &amp; Conduct</td>
</tr>
</tbody>
</table>

**Credits: 6**

#### NATIONAL INTEGRATION AND AWARENESS

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NI 1</td>
<td>National Integration: Importance &amp; Necessity</td>
</tr>
<tr>
<td>NI 2</td>
<td>Factors Affecting National Integration</td>
</tr>
<tr>
<td>NI 3</td>
<td>Unity in Diversity &amp; Role of NCC in Nation Building</td>
</tr>
<tr>
<td>NI 4</td>
<td>Threats to National Security</td>
</tr>
</tbody>
</table>

**Credits: 4**

#### PERSONALITY DEVELOPMENT

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD 1</td>
<td>Self-Awareness, Empathy, Critical &amp; Creative Thinking, Decision Making and Problem Solving</td>
</tr>
<tr>
<td>PD 2</td>
<td>Communication Skills</td>
</tr>
<tr>
<td>PD 3</td>
<td>Group Discussion: Stress &amp; Emotions</td>
</tr>
</tbody>
</table>

**Credits: 7**

#### LEADERSHIP

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>L 1</td>
<td>Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code</td>
</tr>
<tr>
<td>L 2</td>
<td>Case Studies: Shivaji, Jhasi Ki Rani</td>
</tr>
</tbody>
</table>

**Credits: 5**

#### SOCIAL SERVICE AND COMMUNITY DEVELOPMENT

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS 1</td>
<td>Basics, Rural Development Programmes, NGOs, Contribution of Youth</td>
</tr>
<tr>
<td>SS 4</td>
<td>Protection of Children and Women Safety</td>
</tr>
<tr>
<td>SS 5</td>
<td>Road / Rail Travel Safety</td>
</tr>
<tr>
<td>SS 6</td>
<td>New Initiatives</td>
</tr>
<tr>
<td>SS 7</td>
<td>Cyber and Mobile Security Awareness</td>
</tr>
</tbody>
</table>

**Credits: 8**

**TOTAL: 30 PERIODS**
NCC CREDIT COURSE LEVEL 1*

(NAIR FORCE WING) NCC CREDIT COURSE LEVEL – I

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Lecture (L)</th>
<th>Theory (T)</th>
<th>Practicals (P)</th>
<th>Credits (C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NX3253</td>
<td>NCC GENERAL</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>NCC 1 Aims, Objectives &amp; Organization of NCC</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NCC 2 Incentives</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NCC 3 Duties of NCC Cadet</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NCC 4 NCC Camps: Types &amp; Conduct</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NATIONAL INTEGRATION AND AWARENESS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NI 1 National Integration: Importance &amp; Necessity</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NI 2 Factors Affecting National Integration</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NI 3 Unity in Diversity &amp; Role of NCC in Nation Building</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NI 4 Threats to National Security</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PERSONALITY DEVELOPMENT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PD 1 Self-Awareness, Empathy, Critical &amp; Creative Thinking, Decision Making</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PD 2 Communication Skills</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PD 3 Group Discussion: Stress &amp; Emotions</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LEADERSHIP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L 1 Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L 2 Case Studies: Shivaji, Jhasi Ki Rani</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SOCIAL SERVICE AND COMMUNITY DEVELOPMENT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SS 1 Basics, Rural Development Programmes, NGOs, Contribution of Youth</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SS 4 Protection of Children and Women Safety</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SS 5 Road / Rail Travel Safety</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SS 6 New Initiatives</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SS 7 Cyber and Mobile Security Awareness</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TOTAL: 30 PERIODS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:
The main learning objective of this course is to provide hands on training to the students in:

1. Drawing pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
2. Wiring various electrical joints in common household electrical wire work.
3. Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
4. Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

GROUP – A (CIVIL & ELECTRICAL)

PART I CIVIL ENGINEERING PRACTICES

PLUMBING WORK:
   a) Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
   b) Preparing plumbing line sketches.
   c) Laying pipe connection to the suction side of a pump
   d) Laying pipe connection to the delivery side of a pump.
   e) Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:
   a) Sawing,
   b) Planing and
   c) Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

Wood Work Study:
   a) Studying joints in door panels and wooden furniture
   b) Studying common industrial trusses using models.

PART II ELECTRICAL ENGINEERING PRACTICES

a) Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket
b) Staircase wiring
c) Fluorescent Lamp wiring with introduction to CFL and LED types.
d) Energy meter wiring and related calculations/calibration
e) Study of Iron Box wiring and assembly
f) Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
g) Study of emergency lamp wiring/Water heater
GROUP – B (MECHANICAL AND ELECTRONICS)

PART III MECHANICAL ENGINEERING PRACTICES 15

WELDING WORK:
   a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
   b) Practicing gas welding.

BASIC MACHINING WORK:
   a) (simple) Turning.
   b) (simple) Drilling.
   c) (simple) Tapping.

ASSEMBLY WORK:
   a) Assembling a centrifugal pump.
   b) Assembling a household mixer.
   c) Assembling an air conditioner.

SHEET METAL WORK:
   a) Making of a square tray

FOUNDRY WORK:
   a) Demonstrating basic foundry operations.

PART IV ELECTRONIC ENGINEERING PRACTICES 15

SOLDERING WORK:
   a) Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:
   a) Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:
   a) Study an elements of smart phone.
   b) Assembly and dismantle of LED TV.
   c) Assembly and dismantle of computer/ laptop

TOTAL = 60 PERIODS

COUSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.
2. Wire various electrical joints in common household electrical wire work.
3. Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common household equipments; Make a tray out of metal sheet using sheet metal work.
4. Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.
BE3271  BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY

COURSE OBJECTIVES:
- To train the students in conducting load tests on electrical machines
- To gain practical experience in characterizing electronic devices
- To train the students to use DSO for measurements.

LIST OF EXPERIMENTS
1. Verification of ohms and Kirchhoff’s Laws.
2. Load test on DC Shunt Motor.
3. Load test on Self Excited DC Generator
4. Load test on Single phase Transformer
5. Load Test on Induction Motor
6. Characteristics of PN and Zener Diodes
7. Characteristics of BJT, SCR and MOSFET
8. Half wave and Full Wave rectifiers
9. Study of Logic Gates
10. Implementation of Binary Adder and Subtractor
11. Study of DSO

TOTAL: 60 PERIODS

COURSE OUTCOMES:
After completing this course, the students will be able to
1. Use experimental methods to verify the Ohm’s and Kirchhoff’s Laws.
2. Analyze experimentally the load characteristics of electrical machines
3. Analyze the characteristics of basic electronic devices
4. Use DSO to measure the various parameters
OBJECTIVES

- To identify varied group discussion skills and apply them to take part in effective discussions in a professional context.
- To analyse concepts and problems and make effective presentations explaining them clearly and precisely.
- To be able to communicate effectively through formal and informal writing.
- To be able to use appropriate language structures to write emails, reports and essays.
- To give instructions and recommendations that are clear and relevant to the context.

UNIT I

Speaking: Role Play Exercises Based on Workplace Contexts,
- talking about competition-
- discussing progress toward goals-
- talking about experiences-
- talking about events in life-
- discussing past events

Writing: writing emails (formal & semi-formal).

UNIT II

Speaking: discussing news stories-
- talking about frequency-
- talking about travel problems-
- discussing travel procedures-
- talking about travel problems-
- making arrangements-
- describing arrangements-
- discussing plans and decisions-
- discussing purposes and reasons-
- understanding common technology terms

Writing: discussing purposes and reasons-

UNIT III

Speaking: discussing predictions-
- describing the climate-
- discussing forecasts and scenarios-
- talking about purchasing-
- discussing advantages and disadvantages-
- making comparisons-
- discussing likes and dislikes-
- discussing feelings about experiences-
- discussing imaginary scenarios

Writing: short essays and reports (formal/semi-formal letters).

UNIT IV

Speaking: discussing the natural environment-
- describing systems-
- describing position and movement-
- explaining rules (example-
- discussing rental arrangements)
- understanding technical instructions

Writing: writing instructions-

UNIT V

Speaking: describing things relatively-
- describing clothing-
- discussing safety issues (making recommendations)
- talking about electrical devices-
- describing controlling actions

Writing: job application (Cover letter + Curriculum vitae)-writing recommendations.

TOTAL: 60 PERIODS

LEARNING OUTCOMES

At the end of the course, learners will be able
- Speak effectively in group discussions held in a formal/semi formal context.
- Discuss, analyse and present concepts and problems from various perspectives to arrive at suitable solutions.
- Write emails, letters and effective job applications.
- Write critical reports to convey data and information with clarity and precision.
- Give appropriate instructions and recommendations for safe execution of tasks.

Assessment Pattern

- One online/app based assessment to test speaking and writing skills.
- Proficiency certification is given on successful completion of speaking and writing.
CO-PO & PSO MAPPING

<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>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>Avg.</td>
<td>2.4</td>
<td>2.8</td>
</tr>
</tbody>
</table>

- 1-low, 2-medium, 3-high, '-'- no correlation
- **Note:** The average value of this course to be used for program articulation matrix.

MA3352 PROBABILITY AND LINEAR ALGEBRA

**OBJECTIVES**

- To introduce the basic notions of vector spaces which will then be used to solve related problems.
- To understand the concepts of vector space, linear transformations and diagonalization.
- To apply the concept of inner product spaces in orthogonalization.
- To provide necessary basics in probability and random processes that are relevant in applications such as random signals, linear systems in communication engineering.
- To understand the basic concepts of probability, one and two dimensional random variables and to introduce some standard distributions applicable to engineering which can describe real life phenomenon.

**UNIT I** PROBABILITY AND RANDOM VARIABLES

Axioms of probability – Conditional probability – Baye’s theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions - Functions of a random variable.

**UNIT II** TWO- DIMENSIONAL RANDOM VARIABLES

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

**UNIT III** VECTOR SPACES

Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions.

**UNIT IV** LINEAR TRANSFORMATION AND DIAGONALIZATION

Linear transformation - Null spaces and ranges - Dimension theorem - Matrix representation of a linear transformations - Eigenvalues and eigenvectors –Diagonalization.

**UNIT V** INNER PRODUCT SPACES

Inner product, norms - Gram Schmidt orthogonalization process - Adjoint of linear operations - Least square approximation.

**TOTAL : 60 PERIODS**
OUTCOMES:
Upon successful completion of the course, students should be able to:
- Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.
- Demonstrate accurate and efficient use of advanced algebraic techniques.
- Demonstrate their mastery by solving non-trivial problems related to the concepts and by proving simple theorems about the statements proven by the text.
- Understand the fundamental concepts of probability with a thorough knowledge of standard distributions that can describe certain real-life phenomenon.
- Understand the basic concepts of one and two dimensional random variables and apply them to model engineering problems.

TEXT BOOKS

REFERENCES:
COURSE OBJECTIVES:
1. To introduce the students about properties of the fluids, behaviour of fluids under static conditions.
2. To impart basic knowledge of the dynamics of fluids and boundary layer concept.
3. To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on pipe bends.
4. To exposure to the significance of boundary layer theory and its thicknesses.
5. To expose the students to basic principles of working of hydraulic machineries and to design Pelton wheel, Francis and Kaplan turbine, centrifugal and reciprocating pumps.

UNIT I FLUID PROPERTIES AND FLOW CHARACTERISTICS 10+3
Properties of fluids – Fluid statics - Pressure Measurements - Buoyancy and floatation - Flow characteristics - Eulerian and Lagrangian approach - Concept of control volume and system - Reynold’s transportation theorem - Continuity equation, energy equation and momentum equation - Applications.

UNIT II FLOW THROUGH PIPES AND BOUNDARY LAYER 9+3
Reynold’s Experiment - Laminar flow through circular conduits - Darcy Weisbach equation - friction factor - Moody diagram - Major and minor losses - Hydraulic and energy gradient lines - Pipes in series and parallel - Boundary layer concepts - Types of boundary layer thickness.

UNIT III DIMENSIONAL ANALYSIS AND MODEL STUDIES 8+3
Fundamental dimensions - Dimensional homogeneity - Rayleigh’s method and Buckingham Pi theorem - Dimensionless parameters - Similitude and model studies - Distorted and undistorted models.

UNIT IV TURBINES 9+3

UNIT V PUMPS 9+3
Classification of pumps - Centrifugal pumps - Working principle - Heads and efficiencies–Velocity triangles - Work done by the impeller - Performance curves - Reciprocating pump working principle - Indicator diagram and it’s variations - Work saved by fitting air vessels - Rotary pumps.

TOTAL: 60 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to
1. Understand the properties and behaviour in static conditions. Also to understand the conservation laws applicable to fluids and its application through fluid kinematics and dynamics
2. Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel. Also to understand the concept of boundary layer and its thickness on the flat solid surface.
3. Formulate the relationship among the parameters involved in the given fluid phenomenon and to predict the performances of prototype by model studies
4. Explain the working principles of various turbines and design the various types of turbines.
5. Explain the working principles of centrifugal, reciprocating and rotary pumps and design the centrifugal and reciprocating pumps
TEXT BOOKS:

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>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

CE3491 STRENGTH OF MATERIALS

COURSE OBJECTIVES:
- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- To study the stresses and deformations induced in thin and thick shells.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS
Rigid bodies and deformable solids – Tension, Compression and Shear Stresses - Deformation of simple and compound bars – Thermal stresses – Elastic constants - Volumetric strains – Stresses on inclined planes – Principal stresses and principal planes – Mohr’s circle of stress.

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM
UNIT III  
TORSION  
Theory of Torsion – Stresses and Deformations in Solid and Hollow Circular Shafts – Combined bending moment and torsion of shafts - Power transmitted to shaft – Shaft in series and parallel – Closed and Open Coiled helical springs – springs in series and parallel.

UNIT IV  
DEFLECTION OF BEAMS  

UNIT V  
THIN CYLINDERS, SPHERES AND THICK CYLINDERS  
Stresses in thin cylindrical shell due to internal pressure - circumferential and longitudinal stresses - Deformation in thin cylinders – Spherical shells subjected to internal pressure – Deformation in spherical shells – Thick cylinders - Lame's theory.

TOTAL: 45 PERIODS

OUTCOMES:  
At the end of the course the students would be able to
1. Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.
2. Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
3. Apply basic equation of torsion in designing of shafts and helical springs
4. Calculate slope and deflection in beams using different methods.
5. Analyze thin and thick shells for applied pressures.

TEXT BOOK

REFERENCES:
COURSE OBJECTIVES:

- Explain the concepts of workstudy productivity and productivity measurement approaches.
- Plan and record and analyse selected tasks using different flow charts.
- Use method study to improve a task. Apply principles of motion economy to improve performance.
- Plan and conduct a time study to improve the efficiency of the system.
- Appraise the standard times to assess the office work condition.

UNIT I PRODUCTIVITY 9
Work Study and Productivity - Total time for a job or operation, total work content and in effective time, – Production and Productivity-Productivity and standard of living, Factors affecting Productivity, Productivity measurement Models. – procedure of work study

UNIT II METHODS ENGINEERING 9

UNIT III WORK MEASUREMENT 9
Purpose of work measurement –Techniques of work measurement- Time study- Equipment - selecting and timing the job - performance rating –allowances – Standard time – setting timesstandardforworkwith machines-learning effect

UNIT IV APPLIED WORK MEASUREMENT 9
Work sampling and Structured estimating – Group sampling Technique –predetermined time standards (PTS), types - use of time standard - Methods Time Measurement (MTM)-MOSTtechnique-Wageincentive plans.

UNIT V WORK DESIGN FOR OFFICE WORK 9
Method Study in office- Organization and methods(O&M) - Work measurement of office work-WorkAnalysisistechniques applied tosupportstaff-Formdesign andcontrol.

TOTAL:45 PERIODS

COURSE OUTCOMES:

CO1: Ability to understand the concepts of work study productivity and productivity measurement approaches.
CO2: Ability to Record and analyze selected tasks using different flow charts.
CO3: Ability to apply method study to improve a task. Apply principles of motion economy to improve performance.
CO4: Ability to conduct a time study to improve the efficiency of the system.
CO5: Ability to Estimate the standard times to assess the office work condition.

CO’s- PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's 1</th>
<th>PO's 2</th>
<th>PO's 3</th>
<th>PSO's 1</th>
<th>PSO's 2</th>
<th>PSO's 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td></td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVg.</td>
<td>1.5</td>
<td>2</td>
<td>2.5</td>
<td>2</td>
<td>1.33</td>
<td></td>
</tr>
</tbody>
</table>
TEXT BOOKS:

ME3351 ENGINEERING MECHANICS

COURSE OBJECTIVES:
1. To Learn the use scalar and vector analytical techniques for analyzing forces in statically determinate structures.
2. To introduce the equilibrium of rigid bodies, vector methods and free body diagram.
3. To study and understand the distributed forces, surface, loading on beam and intensity.
4. To learn the principles of friction, forces and to determine the apply the concepts of frictional forces at the contact surfaces of various engineering systems.
5. To develop basic dynamics concepts – force, momentum, work and energy.

UNIT I STATICS OF PARTICLES

UNIT II EQUILIBRIUM OF RIGID BODIES

UNIT III DISTRIBUTED FORCES
Centroids of lines and areas – symmetrical and unsymmetrical shapes. Determination of Centroids by Integration, Theorems of Pappus-Guldinus, Distributed Loads on Beams, Centre of Gravity of a Three-Dimensional Body, Centroid of a Volume, Composite Bodies, Determination of Centroids of Volumes by Integration. Moments of Inertia of Areas and Mass - Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas, Moments of Inertia of a Mass - Moments of Inertia of Thin Plates, Determination of the Moment of Inertia of a Three-Dimensional Body by Integration.

UNIT IV FRICTION
The Laws of Dry Friction, Coefficients of Friction, Angles of Friction, Wedge friction, Wheel Friction, Rolling Resistance, Ladder friction.

UNIT V DYNAMICS OF PARTICLES

TOTAL : 45 PERIODS
OUTCOMES:
At the end of the course the students would be able to
1. Illustrate the vector and scalar representation of forces and moments
2. Analyse the rigid body in equilibrium
3. Evaluate the properties of distributed forces
4. Determine the friction and the effects by the laws of friction
5. Calculate dynamic forces exerted in rigid body

TEXT BOOKS:

REFERENCES:

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

Low (1) ; Medium (2) ; High (3)

ME3393 MANUFACTURING PROCESSES L T P C
3 0 0 3

COURSE OBJECTIVES:
1. To illustrate the working principles of various metal casting processes.
2. To learn and apply the working principles of various metal joining processes.
3. To analyse the working principles of bulk deformation of metals.
4. To learn the working principles of sheet metal forming process.
5. To study and practice the working principles of plastics molding.

UNIT I METAL CASTING PROCESSES
UNIT II METAL JOINING PROCESSES


UNIT III BULK DEFORMATION PROCESSES


UNIT IV SHEET METAL PROCESSES


UNIT V MANUFACTURE OF PLASTIC COMPONENTS


OUTCOMES: At the end of the course the students would be able to
1. Explain the principle of different metal casting processes.
2. Describe the various metal joining processes.
3. Illustrate the different bulk deformation processes.
4. Apply the various sheet metal forming process.
5. Apply suitable molding technique for manufacturing of plastics components.

TEXT BOOKS:

REFERENCES:

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

Low (1) ; Medium (2) ; High (3)
COURSE OBJECTIVE:
1. To study the mechanical properties of metals, wood and spring by testing in laboratory.
2. To verify the principles studied in fluid mechanics and machinery theory by performing experiments in laboratory.

UNIT – I STRENGTH OF MATERIALS

LIST OF EXPERIMENTS
1. Tension test on mild steel rod
2. Torsion test on mild steel rod
3. Hardness test on metal (Rockwell and Brinell Hardness)
4. Compression test on helical spring
5. Deflection test on carriage spring

UNIT – II FLUID MECHANICS AND MACHINES LABORATORY

LIST OF EXPERIMENTS
1. (a) Determination of coefficient of discharge of a venturimeter
   (b) Determination of friction factor for flow through pipes
2. (a) Determination of metacentric height
   (b) Determination of forces due to impact of jet on a fixed plate
3. Characteristics of centrifugal pumps
4. Characteristics of reciprocating pump
5. Characteristics of Pelton wheel turbine

TOTAL: 60 PERIODS

OUTCOMES: On completion of the course, the student is expected to be able to
1. Determine the tensile, torsion and hardness properties of metals by testing
2. Determine the stiffness properties of helical and carriage spring
3. Apply the conservation laws to determine the coefficient of discharge of a venturimeter and finding the friction factor of given pipe
4. Apply the fluid static and momentum principles to determine the metacentric height and forces due to impact of jet
5. Determine the performance characteristics of turbine, rotodynamic pump and positive displacement pump.
COURSE OBJECTIVES:
1. To Selecting appropriate tools, equipment’s and machines to complete a given job.
2. To Performing various welding process using GMAW and fabricating gears using gear making machines.
3. To Performing various machining process such as rolling, drawing, turning, shaping, drilling, milling and analysing the defects in the cast and machined components.

LIST OF EXPERIMENTS
1. Fabricating simple structural shapes using Gas Metal Arc Welding machine.
2. Preparing green sand moulds with cast patterns.
3. Taper Turning and Eccentric Turning on circular parts using lathe machine.
4. Knurling, external and internal thread cutting on circular parts using lathe machine.
5. Shaping – Square and Hexagonal Heads on circular parts using shaper machine.
8. Cutting spur and helical gear using milling machine.
13. Cutting force calculation using dynamometer in milling machine.

TOTAL: 60 PERIODS

OUTCOMES: At the end of the course the students would be able to
1. Demonstrate the safety precautions exercised in the mechanical workshop and join two metals using GMAW.
2. The students able to make the work piece as per given shape and size using machining process such as rolling, drawing, turning, shaping, drilling and milling.
3. The students become make the gears using gear making machines and analyze the defects in the cast and machined components.
OBJECTIVES:
To be proficient in important Microsoft Office tools: MS WORD, EXCEL, POWERPOINT.

- To be proficient in using MS WORD to create quality technical documents, by using standard templates, widely acceptable styles and formats, variety of features to enhance the presentability and overall utility value of content.
- To be proficient in using MS EXCEL for all data manipulation tasks including the common statistical, logical, mathematical etc., operations, conversion, analytics, search and explore, visualize, interlink, and utilizing many more critical features offered
- To be able to create and share quality presentations by using the features of MS PowerPoint, including: organization of content, presentability, aesthetics, using media elements and enhance the overall quality of presentations.

MS WORD:
10 Hours
Create and format a document
Working with tables
Working with Bullets and Lists
Working with styles, shapes, smart art, charts
Inserting objects, charts and importing objects from other office tools
Creating and Using document templates
Inserting equations, symbols and special characters
Working with Table of contents and References, citations
Insert and review comments
Create bookmarks, hyperlinks, endnotes footnote
Viewing document in different modes
Working with document protection and security
Inspect document for accessibility

MS EXCEL:
10 Hours
Create worksheets, insert and format data
Work with different types of data: text, currency, date, numeric etc.
Split, validate, consolidate, Convert data
Sort and filter data
Perform calculations and use functions: (Statistical, Logical, Mathematical, date, Time etc.,)
Work with Lookup and reference formulae
Create and Work with different types of charts
Use pivot tables to summarize and analyse data
Perform data analysis using own formulae and functions
Combine data from multiple worksheets using own formulae and built-in functions to generate results
Export data and sheets to other file formats
Working with macros
Protecting data and Securing the workbook

MS POWERPOINT:
10 Hours
Select slide templates, layout and themes
Formatting slide content and using bullets and numbering
Insert and format images, smart art, tables, charts
Using Slide master, notes and handout master
Working with animation and transitions
Organize and Group slides
Import or create and use media objects: audio, video, animation
Perform slideshow recording and Record narration and create presentable videos
OUTCOMES:
On successful completion the students will be able to
- Use MS Word to create quality documents, by structuring and organizing content for their day to day technical and academic requirements
- Use MS EXCEL to perform data operations and analytics, record, retrieve data as per requirements and visualize data for ease of understanding
- Use MS PowerPoint to create high quality academic presentations by including common tables, charts, graphs, interlinking other elements, and using media objects.

IE3491 OPERATIONS RESEARCH

COURSE OBJECTIVES:
- Provide knowledge of optimization techniques and approaches.
- Formulate a real-world problem as a mathematical programming model.
- Enable the students apply mathematical, computational and communication skills needed for the practical utility of Operations Research.
- Knowledge to solve networking problems.
- Knowledge to solve various inventory problems.
- Gain knowledge on solving different waiting line models.

UNIT I LINEAR PROGRAMMING 9

UNIT II ADVANCES IN LINEAR PROGRAMMING 9

UNIT III NETWORK ANALYSIS 9

UNIT IV INVENTORY MODELS 9
Purchase model with no shortages – Manufacturing model with no shortages - Model with price breaks - Reorder point model - Probabilistic inventory model

UNIT V QUEUING THEORY 9
Queueing theory terminology – Single server, multi server- limited and unlimited queue capacity- limited and unlimited population –limited and infinite queue length.

TOTAL: 30 PERIODS
COURSE OUTCOMES:
CO1: Learned to translate a real-world problem, given in words, into a mathematical formulation.
CO2: An understanding of the role of algorithmic thinking in the solution of operations research problems.
CO3: Be able to build and solve Transportation Models and Assignment Models, maximal flow problem, minimum spanning tree and shortest path problem.
CO4: Able to handle issues in various Inventory models.
CO5: The students acquire capability in applying and using of queuing models for day today problems.

COURSE OBJECTIVES:
• To explain the basic concepts of thermodynamics and the first law of thermodynamics.
• To analyze the thermodynamics' second law.
• To assess the qualities of pure materials.
• To obtain a better understanding of mode of heat conduction, convection, and radiation.
• To apply thermodynamic concepts to IC engines, boilers, turbines, refrigeration, and air-conditioning systems.

UNIT I Basics Concepts and First Law of Thermodynamics9+3
Basic concepts; Continuum and macroscopic approach; thermodynamic systems (closed and open); thermodynamic properties and equilibrium; state of a system, state postulate for simple compressible substances, paths and processes on state diagrams; concepts of heat and work, different modes of work; zeroth law of thermodynamics; concept of temperature. First Law of Thermodynamics; Concept of energy and various forms of energy.
energy; internal energy, enthalpy; specific heats; first law applied to elementary processes, closed systems and control volumes, steady and unsteady flow analysis

UNIT II  SECOND LAW OF THERMODYNAMICS  9+3
Second law of thermodynamics; Limitations of the first law of thermodynamics, concepts of heat engines and heat pumps/refrigerators, Kelvin-Planck and Clausius statements and their equivalence; reversible and irreversible processes; Carnot cycle and Carnot theorems; thermodynamic temperature scale; Clausius inequality and concept of entropy; the principle of increase of entropy, T-s diagrams; second law analysis of control volume; availability and irreversibility; third law of thermodynamics.

UNIT III  PROPERTIES OF PURE SUBSTANCE  9+3
Thermodynamic properties of pure substances in solid, liquid and vapour phases; P-v-T behaviour of simple compressible substances, thermodynamic property tables and charts, psychrometric charts ideal and real gases: Vander waals equations - Reduced property - Compressibility chart - Properties of mixture of gases - Dalton’s law and Gibbs - Internal energy, Enthalpy and specific heats of gas mixtures.

UNIT IV  BASICS OF HEAT TRANSFER  9+3

UNIT V  APPLICATIONS OF THERMODYNAMIC CYCLES  9+3

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of this course the students shall be able to:
CO1. Apply first law of thermodynamics to engineering applications.
CO2. Differentiate first and second law of thermodynamics.
CO3. Examine the properties of real and ideal gas mixtures using thermodynamic charts.
CO4. Evaluate the heat transfer through conduction, convection and radiation
CO5. Analyze the thermodynamic operations on IC engine, boilers, turbine, refrigerator etc.

CO’s- PO’s & PSO’s MAPPING

<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>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Avg</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2.6</td>
<td>2.4</td>
<td>2.6</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2.4</td>
<td>3</td>
<td>3</td>
<td>2.4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TEXT BOOKS:

REFERENCES:

IE3452 APPLIED ERGONOMICS

COURSE OBJECTIVES:
- Explain the knowledge of basic human science and Engineering science.
- Teach skills associated with ergonomic measurement methods and analytical techniques to workplace ergonomic problems.
- Plan and conduct an ergonomic analysis and ergonomic recommendations for modern work environment problems.
- Use the occupational health and safety rules to improve the workplace.
- Teach and apply ergonomic principles to design workplaces for the improvement of human performance.

UNIT I INTRODUCTION
Brief history of human factors Engineering/Ergonomics – Interdisciplinary nature – Human–machine systems -Ergonomics and its areas of application in the work system - Future directions for ergonomics- Biostatic and Biodynamic Mechanics

UNIT II WORK PLACE DESIGN
Problems of body size- Anthropometry measures- Work posture – Design for standing and seated workers - Design of repetitive tasks - Design of manual handling tasks- VDT work stations – Handtool design

UNIT III PHYSIOLOGICAL ASPECTS OF HUMAN AT WORK
Stress and fatigue -Physical work capacity - Physiological factors affecting work capacity – Fitness for work –Working hours and shift work- Quantitative work load analysis – Psychological work Demands.

UNIT IV DESIGN OF ENVIRONMENT

UNIT V HUMAN PERFORMANCE
Human Information receiving and processing – Information theory and its application – Cognitive systems - Mental Work Load -Signal detection theory – Design of Displays and controls
COURSE OUTCOMES:
CO1: Ability to apply Knowledge of basic human science and Engineering science.
CO2: Ability to Apply skills associated with ergonomic measurement methods and analytical techniques to workplace ergonomic problems.
CO3: Ability to conduct an ergonomic analysis and ergonomic recommendations for modern work environment problems.
CO4: Ability to implement the occupational health and safety rules to improve the work place.
CO5: Ability to apply ergonomic principles to design workplaces for the improvement of human performance.

TEXT BOOKS:

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</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’s</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>1</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>
<tr>
<td>2</td>
<td></td>
<td>2</td>
<td>3</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>
<tr>
<td>3</td>
<td></td>
<td>3</td>
<td>3</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>
<tr>
<td>4</td>
<td></td>
<td>2</td>
<td>3</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>
<tr>
<td>5</td>
<td></td>
<td>3</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>
<tr>
<td>Avg.</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td>2.6</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1.3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

IM3401 HUMAN RESOURCE MANAGEMENT

OBJECTIVES:
- To provide knowledge about management issues related to staffing,
- To provide knowledge about management issues related to training,
- To provide knowledge about management issues related to performance
- To provide knowledge about management issues related to compensation
- To provide knowledge about management issues related to human factors consideration and compliance with human resource requirements.

UNIT I INTRODUCTION TO HUMAN RESOURCE MANAGEMENT

UNIT II HUMAN RESOURCE PLANNING
UNIT III TRAINING AND EXECUTIVE DEVELOPMENT
Types of training and Executive development methods – purpose – benefits.

UNIT IV EMPLOYEE COMPENSATION

UNIT V PERFORMANCE EVALUATION AND CONTROL

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Students would have gained knowledge on the various aspects of HRM
CO2: Students will gain knowledge needed for success as a human resources professional.
CO3: Students will develop the skills needed for a successful HR manager.
CO4: Students would be prepared to implement the concepts learned in the workplace.
CO5: Students would be aware of the emerging concepts in the field of HRM

TEXT BOOKS:

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Avg.</td>
<td>2.8</td>
<td>2.8</td>
</tr>
</tbody>
</table>

COURSE OBJECTIVES:
1. To understand the principles in the formation of mechanisms and their kinematics.
2. To learn the basic concepts of toothed gearing and kinematics of gear trains.
3. To study the effect of friction in different machine elements.
4. To analyze the forces and torque acting on simple mechanical systems
5. To understand the importance of balancing and vibration

UNIT I KINEMATIC ANALYSIS IN SIMPLE MECHANISMS AND CAMS
UNIT II TOOTHE GEARING AND GEAR TRAINS


UNIT III FRICTION ASPECTS IN MACHINE COMPONENTS


UNIT IV STATIC AND DYNAMIC FORCE ANALYSIS


UNIT V BALANCING OF ROTATING MASSES AND VIBRATION


TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

1. Design the linkages and the cam mechanisms for specified output motions.
2. Determine the gear parameters of toothed gearing and speeds of gear trains in various applications.
3. Evaluate the frictional torque in screw threads, clutches, brakes and belt drives.
4. Determine the forces on members of mechanisms during static and dynamic equilibrium conditions.
5. Determine the balancing masses on rotating machineries and the natural frequencies offree and forced vibratory systems.

TEXT BOOK


REFERENCES

5. Thomas Bevan, “The Theory of Machines”, Pearson Education Ltd., 2010

<table>
<thead>
<tr>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>PO2</td>
<td>PO3</td>
<td>PO4</td>
<td>PO5</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2.5</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>2.5</td>
<td>2.5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2.5</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2.5</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2.5</td>
<td>2</td>
</tr>
<tr>
<td>Avg.</td>
<td>3</td>
<td>2.7</td>
<td>2.9</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PO7</th>
<th>PO8</th>
<th>PO9</th>
<th>PO10</th>
<th>PO11</th>
<th>PO12</th>
<th>PS01</th>
<th>PS02</th>
<th>PS03</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>0.8</td>
<td>-</td>
<td>-</td>
<td>0.8</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
OBJECTIVES:

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasize on the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

UNIT I ENVIRONMENT AND BIODIVERSITY


UNIT II ENVIRONMENTAL POLLUTION


UNIT III RENEWABLE SOURCES OF ENERGY

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV SUSTAINABILITY AND MANAGEMENT

Development, GDP, Sustainability- concept, needs and challenges-economic, social and aspects of sustainability-from unsustainability to sustainability-millennium development goals, and protocols-Sustainable Development Goals-targets, indicators and intervention areas Climate change- Global, Regional and local environmental issues and possible solutions-case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry-A case study.

UNIT V SUSTAINABILITY PRACTICES


TOTAL : 30 PERIODS
OUTCOMES:

- To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.
- To identify the causes, effects of environmental pollution and natural disasters and contribute to the preventive measures in the society.
- To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve them for future generations.
- To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.
- To demonstrate the knowledge of sustainability practices and identify green materials, energy cycles and the role of sustainable urbanization.

TEXT BOOKS:

5. Bradley, A.S; Adebayo, A.O., Maria, P. Engineering applications in sustainable design and development, Cengage learning.

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>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td>2.8</td>
<td>1.8</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>2.2</td>
<td>2.4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.8</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>

- 1-low, 2-medium, 3-high, -"- no correlation
IM3411 WORK SYSTEM DESIGN AND ERGONOMICS LABORATORY

COURSE OBJECTIVE:

- To understand the theory better and apply in practice, practical training is given in the following areas
- To test the principles of human factors engineering in a laboratory

1. Graphic tools for method study
   a) outline process chart
   b) Flow Process Chart
   c) Two handed process Chart

2. Peg board experiment

3. Stop watch time study

4. Performance rating exercise
   a) Walking rating
   b) Card dealing

5. Work sampling

6. MTM practice

7. Effect of speed of walking on treadmill using heart rate and energy expenditure

8. Effect of workload on heart rate using Ergo cycle.

9. Evaluation of physical fitness using step test

10. Analysis of noise level in different environment

11. Study of Illumination of work places.

12. Evaluation of cognitive performance of individuals

TOTAL: 45 PERIODS

OUTCOMES:

Students should be able

CO1: Ability to record and analyze selected tasks using different recording techniques

CO2: Ability to conduct a time study to improve the efficiency of the system.

CO3: Ability to apply MTM to improve the efficiency of the system.

CO4: Ability to design the workplace with ergonomics consideration

CO5: Ability to assess the cognitive performance of the individuals.

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>AVG.</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
IE3461  OPTIMIZATION LABORATORY  L T P C
0 0 3 1.5

COURSE OBJECTIVES:

- Give adequate exposure to use different optimization software packages for solving Operations Research problems.
- Practice to solve Linear programming problems.
- Learn problem solving techniques, writing algorithms and procedures.
- Solve optimization problems using 'C' programming language.
- Practice C code for simple logic on OR problem.

LABORATORY EXPERIMENTS

- Experiment 1: LP Models formulation and solving using softwares
- Experiment 2: Formulation of Transportation Problem and solving using software package
- Experiment 3: Formulation of Assignment Problems and solving using software package
- Experiment 4: Solving Maximal Flow problem
- Experiment 5: Solving Minimal Spanning Tree problems
- Experiment 6: Solving shortest route problems
- Experiment 7: Solving Project Management problems
- Experiment 8: Solving Waiting line problems
- Experiment 9: Solving Queuing problems
- Experiment 10: Solving Inventory problems

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Use computer tools to solve a mathematical model for practical problems.
CO2: Acquired knowledge in using Optimization Software Package.
CO3: Ability to develop C++ programming for solving optimization problem.
CO4: Able to design new simple models, like: CPM, MSPT to improve decision-making develop critical thinking and objective analysis of decision problems.
CO5: Ability to use logical thinking for solving OR problem.

CO’s - PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVg.</td>
<td>3</td>
<td>2.6</td>
</tr>
</tbody>
</table>

AVG. 3 2.6 3 2.7 2.3 1.5 3 2.5 3 2
COURSE OBJECTIVES:

- Developing a clear knowledge in the basics of various quality concepts.
- Facilitating the students in understanding the application of control charts and its techniques.
- Developing the special control procedures for service and process oriented industries.
- Analyzing and understanding the process capability study.
- Developing the acceptance sampling procedures for incoming raw material.

UNIT I QUALITY FUNDAMENTALS 9

UNIT II CONTROL CHARTS FOR VARIABLES 9

UNIT III STATISTICAL PROCESS CONTROL 9
Process stability- process capability study using control charts- capability evaluation- Cp, Cpk and Cpm – capability analysis using histogram and normal probability plot- machine capability study- gauge capability study- setting statistical tolerances for components and assemblies- individual measurement charts- X-chart, moving average and moving range chart, multi-vari chart.

UNIT IV CONTROL CHARTS FOR ATTRIBUTES 9
Limitations of variable control charts- Control charts for fraction non-conforming- p and np charts- variable sample size, operating characteristic function, run length- Control chart for nonconformities(defects)- c, u, ku charts- demerits control chart- applications.

UNIT V ACCEPTANCE SAMPLING 9
Need- economics of sampling- sampling procedure- single and double sampling- O.C. Curves- Average outgoing quality- Average sample number- Average total inspection- Multiple and sequential sampling- Standard sampling plans- Military, Dodge-Roming, IS 2500.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students will be able to:
CO1: Control the quality of processes using control charts for variables in manufacturing industries.
CO2: Control the occurrence of defective product and the defects in manufacturing companies.
CO3: Control the occurrence of defects in services.
CO4: Analyzing and understanding the process capability study.
CO5: Developing the acceptance sampling procedures for incoming raw material.
### CO’s, PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</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’s 1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>AVg.</td>
<td>2</td>
<td>2.2</td>
<td>2</td>
<td>2.2</td>
<td>1.8</td>
<td>1.6</td>
<td>2</td>
<td>1.8</td>
<td>1.4</td>
<td>1.8</td>
<td>2.4</td>
<td>1.8</td>
<td>2.1</td>
<td>1.3</td>
<td>2</td>
</tr>
</tbody>
</table>

### TEXT BOOKS:

### REFERENCES:

### IE3551 PRODUCTION AND OPERATIONS MANAGEMENT

**COURSE OBJECTIVES:**
- Recognize and appreciate the concept of Production and Operations Management in creating and enhancing a firm’s competitive advantages.
- Describe the concept and contribution of various constituents of Production and Operations Management (both manufacturing and service).
- Relate the interdependence of the operations function with the other key functional areas of a firm.
- Teach analytical skills and problem-solving tools to the analysis of the operations problems.
- Apply scheduling and Lean Concepts for improving System Performance.

### UNIT I INTRODUCTION


### UNIT II FORECASTING

Need, Determinants of Demand, Demand Patterns, Qualitative Forecasting Methods-Delphi techniques. Market Research, Nominal Group Technique. Quantitative Forecasting methods – Moving Average Methods, Exponential Smoothing Methods, Regression methods, Monitoring and Control of Forecasts, Requirements and Selection of Good forecasting methods.
UNIT III  AGGREGATE PLANNING AND MATERIAL REQUIREMENT PLANNING

Role of aggregate Product planning, Managerial inputs to Aggregate planning, Pure and Mixed strategies, Mathematical Models for Aggregate planning – Transportation Method, Linear programming Formulation, Linear Decision Rues, Master Production Schedule(MPS), Procedure for developing MPS, MRP -Lot sizing methods – Implementation issues, MRP – II, Introduction to ERP.

UNIT IV  CAPACITY MANAGEMENT


UNIT V  PRODUCTION ACTIVITY CONTROL AND LEAN MANUFACTURING

Objectives and Activities of Production Activity Control -JIT- Kanban- Introduction to Scheduling in different types of Production Systems. Lean Manufacturing - Principles – Activities - Tools and techniques - Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: The students will appreciate the role of Production and Operations management in enabling and enhancing a firm’s competitive advantages in the dynamic business environment.
CO2: The students will obtain sufficient knowledge and skills to forecast demand for Production and Service Systems.
CO3: The students will able to Formulate and Assess Aggregate Planning strategies and Material Requirement Plan.
CO4: The students will be able to develop analytical skills to calculate capacity requirements and developing capacity alternatives.
CO5: The students will be able to apply scheduling and Lean Concepts for improving System Performance.

CO’s- PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</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>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td>3</td>
<td>3</td>
<td>2.7</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

TEXT BOOK:

REFERENCES:
COURSE OBJECTIVES:
1. To acquaint the skills and practical experience in handling 2D drafting and 3D modelling software systems, standard drawing practices using fits and tolerances.
2. To prepare assembly drawings both manually and using standard CAD packages.
3. To preparing standard drawing layout for modeled parts, assemblies with BoM.

PART I DRAWING STANDARDS & FITS AND TOLERANCES 12

PART II 2D DRAFTING 48
Drawing, Editing, Dimensioning, Layering, Hatching, Block, Array, Detailing, Detailed Drawing.
1. Bearings – Bush Bearing,
3. Couplings – Flange, Oldham’s, Muff, Gear couplings.
5. Engine parts – Piston, Connecting Rod, Crosshead (vertical and horizontal), Stuffing box, multi-plate clutch.

Total: 20% of classes for theory classes and 80% of classes for practice
Note: 25% of assembly drawings must be done manually and remaining 75% of assembly drawings must be done by using any CAD software. The above tasks can be performed manually and using standard commercial 2D CAD software.

OUTCOMES:
At the end of the course the students would be able to
1. Prepare standard drawing layout for modelled assemblies with BoM.
3. Prepare standard drawing layout for modelled parts

TEXT BOOKS:

REFERENCES:
CIE359 MANAGEMENT ACCOUNTING AND FINANCIAL MANAGEMENT  

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

Low (1) ; Medium (2) ; High (3)

COURSE OBJECTIVES:

- Understanding the Basics of accounting and accounting standards.
- Evaluating P&L statements, Balance sheets and other accounting statements.
- Learn and apply the various cost accounting methods.
- Study the various cost control procedures.
- Sketch and prepare a budget and make investment decision

UNIT I  INTRODUCTION

UNIT II  FINANCIAL ACCOUNTING
Salient features of Balance Sheet and Profit and Loss statement, cash flow and Fund flow analysis (Elementary), working capital management, ratio analysis – Depreciation.

UNIT III  COST ACCOUNTING
Cost accounting systems: Job Costing, process costing, allocation of overheads, Activity based costing, variance analysis – marginal costing – Break even analysis.

UNIT IV  BUDGETING
Requirements for a sound budget, fixed budget – preparation of sales and production budget, flexible budgets, zero based budgets and budgetary control.

UNIT V  FINANCIAL MANAGEMENT
Investment decisions – Investment appraisal techniques – payback period method, accounting rate of return, net present value method, internal rate of return and profitability index method-cost of capital

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon successful completion of the course,
- Students will acquire the ability to understand the basic concepts of accounting
- Students will acquire the ability to prepare and analyze the financial statements
- Students will acquire the ability to comprehend nuances involved in costing
- Students will acquire the ability to analyse draft budgets
- Students will acquire the ability to make sound investment decisions.

TEXT BOOKS:

REFERENCES:

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>1 2</td>
<td>3 3 2</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>3 3 2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3 2 3</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>3 2 3</td>
</tr>
<tr>
<td>AVg.</td>
<td>2.5</td>
<td>1 2 3</td>
</tr>
</tbody>
</table>

IE3791 SIMULATION MODELING AND ANALYSIS

COURSE OBJECTIVE:
- Define the basics of simulation modeling and replicating the practical situations in organizations
- Generate random numbers and random variates using different techniques.
- Develop simulation model using heuristic methods.
- Analysis of Simulation models using input analyzer, and output analyzer
- Explain Verification and Validation of simulation model.

UNIT I  INTRODUCTION
Systems – Modelling – types – systems components – Simulation basics

UNIT II  RANDOM NUMBERS/VARIATES
Random numbers – methods of generation – random variates for standard distributions like uniform, exponential, Poisson, binomial, normal etc – Testing of Random variates –Monte Carlo Simulation
UNIT III  DESIGN OF SIMULATION EXPERIMENTS  9
Steps on Design of Simulation Experiments – Development of models using of High-level
language for systems like Queuing, Inventory, Replacement, Production etc., –
Model validation and verification, Output analysis.

UNIT IV  SIMULATION LANGUAGES  9
Need for simulation Languages – Comparisons & Selection of Languages –Study of any one
of the languages

UNIT V  CASE STUDIES USING SIMULATION LANGUAGES  9
Waiting line models, inventory models, and production models.

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: Able to generate random numbers and random variates.
CO2: Able to test the statistical stability of random variates
CO3: Able to develop simulation models for real life systems
CO4: How to use simulation language to simulate and analyze various problems.
CO5: Able to solve waiting line model, inventory models and production models problems
using simulation software.

CO’s- PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</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’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</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>2</td>
<td>3</td>
<td>3</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>1</td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td>2.5</td>
<td>2.1</td>
<td>2.3</td>
<td>2.7</td>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:
1. David Kelton, Rondall P Sadowski and David T Sturrock, “Simulation with Arena”,
2. Jerry Banks, JohnSCorson, Barry.L. Nelson, DavidM.Nicol and P.Shahabudeen,
COURSE OBJECTIVES:

- Develop C program to generate random number and random variates.
- Develop C program to test random number and random variates.
- Apply Monte Carlo simulation for random walk problem and paper vendor problem.
- Develop simulation model using simulation software for different queuing models.
- Develop simulation model using simulation software for inventory models.

LIST OF EXPERIMENTS:

1. Generate Random Number by Mid Square, Midpoint and Congruential method using ‘C’ program.
2. Generate Poisson random variate, uniform random variate using ‘C’ program.
4. Testing random numbers and random variates for their uniformity.
5. Testing random numbers and random variates for their independence.
7. Solve paper vendor problem using Monte Carlo simulation.
8. Solve single server queuing model using simulation software package.
10. Solve inventory model using simulation software package.

SOFTWARES REQUIREMENTS:
Simulation software package

TOTAL: 30 PERIODS

COURSE OUTCOMES:

CO1: Know to generate random number and random variates
CO2: Learn to test the random number and random variates
CO3: Able to apply Monte Carlo simulation for random walk and paper vendor problems.
CO4: Able to apply simulation software to various queuing models.
CO5: Know to use simulation software to various inventory models.

CO’s - PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVg.</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

91
COURSE OBJECTIVES

- Describe the role and drivers of and supply chain management in achieving competitiveness.
- Explain about Supply Chain Network Design.
- Illustrate about the issues related to Logistics in Supply Chain.
- Appraise about Sourcing and Coordination in Supply Chain.
- Application of Information Technology and Emerging Concepts in Supply Chain.

UNIT I STRATEGIC FRAMEWORK 9
Role of Logistics and Supply Chain Management: Scope and Importance - Evolution of Supply Chain - Examples of supply Chains - Decision Phases in Supply Chain - Competitive and Supply Chain Strategies – Drivers of Supply Chain Performance and Obstacles.

UNIT II SUPPLY CHAIN NETWORKS 9
Distribution networks, Facility networks and design options, Factors influencing, Models for facility location and capacity allocation, Transportation networks and design options, Evaluating network design decisions.

UNIT III MANAGING DEMAND AND SUPPLY IN A SUPPLY CHAIN 9
Predictable variability in a supply chain, Economies of scale and uncertainty in a supply chain—Cycle and safety inventory, Optimum level of product availability, Forward Buying, Multi-echelon cycle inventory.

UNIT IV SOURCING AND PRICING IN A SUPPLY CHAIN 9
Cross-Functional drivers, Role of sourcing in a supply chain, Logistics providers, Procurement process, Supplier selection, Design collaboration, Role of Pricing and Revenue Management in a supply chain.

UNIT V INFORMATION TECHNOLOGY AND COORDINATION IN A SUPPLY CHAIN 9
The role of IT in supply chain, The supply chain IT framework, Customer Relationship Management, Supplier relationship management, Future of IT in supply chain, E-Business in supply chain, Bullwhip effect – Effect of lack of co-ordination in supply chain, Building strategic partnerships, CPFR.

COURSE OUTCOMES:

After undergoing this course, students will acquire

CO1: Ability to understand the scope of Supply Chain Management and the Drivers of SC performance.

CO2: Ability to design suitable SC network for a given situation.

CO3: Ability to solve the issues related to Logistics in SCM.

CO4: Ability to understand Sourcing, Coordination and current issues in SCM.

CO5: Ability to appraise about the applications of IT in SCM and apply SCM concepts in selected enterprise.
### CO's- PO's & PSO's MAPPING

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Avg.</td>
<td>2.8</td>
<td>3</td>
</tr>
</tbody>
</table>

### TEXT BOOK:

### REFERENCES:

### COURSE OBJECTIVES:
- To review and clarify the fundamental terms, concepts and theories associated with Decision Support Systems, computerized decision aids, expert systems, group support systems and executive information systems.
- To discuss and develop skills in the analysis, design and implementation of computerized Decision Support Systems.
- To examine the uses of various mathematical models, heuristics and simulation as a sub-system of DSS.
- To understand that most Decision Support Systems are designed to support rather than replace decision makers and the consequences of this perspective for designing DSS.

### UNIT I
**INTRODUCTION**
Managerial decision making, system modeling and support - preview of the modeling process- phases of decision making process.

### UNIT II
**ANALYSIS**
DSS components- Data warehousing, access, analysis, mining and visualization-modeling and analysis-DSS development.

### UNIT III
**TECHNOLOGIES**
Group support systems- Enterprise DSS- supply chain and DSS - Knowledge management methods, technologies and tools.
UNIT IV EXPERT SYSTEMS
Artificial intelligence and expert systems - Concepts, structure, types - Knowledge acquisition and validation - Difficulties, methods, selection.

UNIT V SEMANTIC NETWORKS
Representation in logic and schemas, semantic networks, production rules and frames, inference techniques, intelligent system development, implementation and integration of management support systems.

OUTCOMES:
CO1: Make decisions in the semi structured and unstructured problem situations.
CO2: Able to apply data warehousing and data mining principles in basic applications.
CO3: Develop knowledge management systemwith simple tools and techniques.
CO4: Develop intelligent based DSS.
CO5: Able to use logical and analytical thinking

TEXT BOOKS:

REFERENCES:

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 2 3</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3 2 3</td>
</tr>
<tr>
<td>3</td>
<td>3 3 3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2 3 2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>AVg.</td>
<td>2.8 3 2.5 2 2 2 2.6</td>
<td>2.5</td>
</tr>
</tbody>
</table>

IM3711 DATA ANALYTICS LABORATORY

COURSE OBJECTIVES:
This course aims to:
- Design a data analysis strategy that answers a hypothesis, including specifications for data elements, requirements of the statistic, and limitations to the interpretation.
- Understand how to select appropriate techniques
- Understand how to conduct a variety of statistical analyses, including testing of statistical assumptions, data transformations, and validation of statistical findings
- Understand how to interpret the results of statistical analyses.
- Understand how to present the results of statistical analyses.

Students will perform analysis of data in the following topics using Data Analysis package
1. Control Charts
2. Correlation Analysis
3. Simple Regression
4. Multiple Regression
5. Single factor Experiment
6. Factorial experiment
7. Factor Analysis
8. Discriminant Analysis
9. Cluster Analysis
10. Estimation of model parameters of the system to predict Reliability

**COURSE OUTCOMES:**
Upon completion of the laboratory course, the students will
CO1: Able to independently formulate, perform and assess hypothesis
CO2: Able to select appropriate techniques
CO3: Able to apply various data analysis techniques
CO4: Able to interpret the results
CO5: Able to present the results properly to extract meaningful information from data sets for effective decision making

**MAPPING OF COS AND POS:**

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Avg.</td>
<td>2.4</td>
<td>3</td>
</tr>
</tbody>
</table>

**IM3811 PROJECT WORK**

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>20</td>
<td>10</td>
</tr>
</tbody>
</table>

**COURSE OBJECTIVES:**
The objectives of this course are to:
1. To make them understand the concepts of Project work for planning to execution of projects.
2. To make them understand the feasibility analysis in Project work and network analysis tools for cost and time estimation.
3. To enable them to comprehend the fundamentals.
4. Make them capable to analyze, apply and appreciate contemporary project work tools and methodologies

To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination. The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

**TOTAL: 300 PERIODS**
COURSE OUTCOMES:
On completion of this course, the students will be able to:
1. Understand project characteristics and various stages of a project.
2. Understand the conceptual clarity about project organization and feasibility analyses and Technical.
3. Analyze the learning and understand techniques for Project work planning, scheduling and Execution.
4. Understand the report preparation and presentation.
5. Understand the How present in conference and facing the quires.

MAPPING OF COS AND POS:

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 3 3</td>
<td>2 3 1</td>
<td>1 1 1 3 3 3</td>
</tr>
<tr>
<td>2 3 2</td>
<td>2 2 2</td>
<td>2 2 2 2 3 2</td>
</tr>
<tr>
<td>3 2 3</td>
<td>3 2 2</td>
<td>2 3 2 2 2 2</td>
</tr>
<tr>
<td>4 2 1</td>
<td>2 2 2</td>
<td>2 3 2 2 2 2</td>
</tr>
<tr>
<td>5 3 3</td>
<td>2 2 2</td>
<td>2 2 2 2 2 2</td>
</tr>
<tr>
<td>AVg. 2.6 2.4 2.3</td>
<td>2.2 1 1 1</td>
<td>2.2 2.6 2</td>
</tr>
</tbody>
</table>

CIE331 PROJECT MANAGEMENT

COURSE OBJECTIVES:
- Knowledge to evaluate and select the most desirable projects.
- Ability to plan and implement the projects.
- Ability to control the projects.
- Knowledge to close the projects.
- Knowledge about software projects.

UNIT I INTRODUCTION TO PROJECT MANAGEMENT AND PROJECT SELECTION

UNIT II PROJECT RISK MANAGEMENT

UNIT III PROJECT PLANNING AND IMPLEMENTATION
Work break down structure- Estimate work packages – Identify task relationship – project schedule

UNIT IV PROJECT MONITORING AND CONTROL
Resource aggregations - Resource levelling - limited resource allocation – project monitoring and control.

UNIT V PROJECT CLOSURE AND SPECIAL TOPICS
Process project audit – post project audit – normal project closure – premature closure – perpetual project - project closure process. Project management for modern information
system – critical success factors for IT project - software project selection and initiation - project management discipline – project overall planning  

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Evaluate and select the most desirable projects.
CO2: Apply appropriate approaches to plan a new project.
CO3: Apply appropriate methodologies to develop a project schedule.
CO4: Identify important risks facing a new project.
CO5: Understanding the project management skills in IT industries.

CO’s- PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td>3</td>
<td>2.6</td>
</tr>
</tbody>
</table>

TEXT BOOK:

REFERENCES:

CIE332  PRODUCT DESIGN AND VALUE ENGINEERING  L T P C

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

COURSE OBJECTIVES:
- Relate product development integrated with value engineering.
- Summarize the development of new products through conceptualization, design and development phases.
- Relate various aspects of product development with industrial design and manufacturing.
- Describe the value of a product using tools and techniques.
- Design products which are suitable for the needs of the society.

UNIT I  VALUE ENGINEERING BASICS  9
Origin of Value Engineering, Meaning of value, Definition of Value Engineering and Value analysis, Difference between Value analysis and Value Engineering, Types of Value, function - Basic and Secondary functions, concept of cost and worth, creativity in Value Engineering.

UNIT II  VALUE ENGINEERING JOB PLAN AND PROCESS  9
Seven phases of job plan, FAST Diagram as Value Engineering Tool, Behavioural and organizational aspects of Value Engineering, Ten principles of Value analysis, Benefits of Value Engineering.
UNIT III IDENTIFYING CUSTOMER NEEDS and PRODUCT SPECIFICATIONS

UNIT IV CONCEPT GENERATION, SELECTION AND PRODUCT ARCHITECTURE

UNIT V INDUSTRIAL DESIGN, PROTOTYPING AND ECONOMICS OF PRODUCT DEVELOPMENT
Need for industrial design – Impact of industrial design – Industrial design process – Management of industrial design process – Assessing the quality of industrial design.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: The Students should be able to understand the basic concept of product development.
CO2: Design and develop new products in a systematic manner considering the concept of value engineering.
CO3: Able to understand customer requirements.
CO4: Able to understand product architecture.
CO5: Able to do prototyping.

CO’s- PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</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’s</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>3</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td>2.6</td>
<td>2.7</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES:
- Explain the basic principles in facilities planning and plant location.
- Interpret the basic principles in facility layout design decisions through proper analysis.
- Illustrate and explain various modern trends while designing a layout.
- Develop knowledge in line balancing concepts to implement improved system.
- Summarize basic principles in designing, measuring and analyzing material flow to improve the efficiency of the system.

UNIT I PLANT LOCATION
Introduction, Factors affecting location decisions, Qualitative models, Quantitative models, Break-Even analysis model, Brown & Gibbs model, Single facility location models, Gravity location models, Mini-Sum model, Mini-Max model, Multi facility location models, Covering model, Warehouse location model.

UNIT II FACILITIES LAYOUT DESIGN
Need for layout study, COURSE OBJECTIVES of a good facility layout, Classification of layout, Layout procedure – Nadler’s ideal system approach – Immer’s basic steps – Apple’s layout procedure – Reed’s layout procedure, Layout planning – Systematic layout planning(SLP) – Information gathering, Flow analysis & Activity analysis, Relationship diagram, Space requirement and availability, Designing the layout.

UNIT III COMPUTERIZED LAYOUT PLANNING
Designing the process layout – CRAFT, ALDEP, CORELAP – Trends in computerized layout, Group technology models – Production flow analysis (PFA) – Rank order clustering (ROC).

UNIT IV DESIGNING PRODUCT LAYOUT

UNIT V MATERIALS HANDLING AND PACKAGING
Scope and definitions of material handling – COURSE OBJECTIVES, Principles of material handling, Unit load concept, Material handling system design, Classification of material handling equipments, Equipment selection & specification, JIT impact on facilities design, Packaging.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students should be able to
CO1: apply and evaluate appropriate location models for various facility types.
CO2: effectively design and analyze various facility layouts.
CO3: apply and analyze various computerized techniques while designing a layout.
CO4: effectively implement a strategy to level the workload across all the workstations.
CO5: implement smooth and cost effective system in the material handling process.
CO's- PO's & PSO's MAPPING

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>AVg.</td>
<td>3</td>
<td>2.6</td>
</tr>
</tbody>
</table>

TEXT BOOK:

REFERENCES:

CIE334 BUSINESS PROCESS RE-ENGINEERING

COURSE OBJECTIVES:
- To understand concepts and philosophy of Business Process Reengineering.
- To learn various BPR and alternate methodologies – TQM, Work Study, ISO standards practiced in the industry.
- To understand and analyze the role of Information Technology and change management in the implementation of BPR.
- To expose practically BPR implementation and best practices through research papers and case discussions.

UNIT I PROCESS VIEW OF BUSINESS

UNIT II BPR: METHODOLOGIES AND TECHNIQUES & APPLICATIONS
UNIT III CRITICAL SUCCESS FACTORS ANALYSIS 9
Reengineering Success Factors, Risks associated with BPR, Barriers to BPR, Case: Analysis on “Pillsbury: Customer Driven Reengineering”, Barriers Management, Case: “Walmart China- Supply Chain Transformation”

UNIT IV BPR Vs OTHER IMPROVEMENT APPROACHES 9

UNIT V INFORMATION TECHNOLOGY AND BPR 9
Role of IT in Reengineering, Criticality of IT in Business Process, BPR Team Characteristics, Threads of BPR in Various Phases, Case: “Otis Elevator: Accelerating Business Transformation with IT”, BPR, SAP and ERP, Elements of ERP, Applications of ERP

COURSE OUTCOMES:
On completion of this course, the students will be able to

CO1. Understanding various BPR methodologies and their applications.

CO2. Understanding the critical success factors for implementing BPR.


CO5. Analyze and integrate issues and challenges of applying tools/techniques of Information Technology for BPR and learn to apply them in the industry.

CO’s- PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</th>
<th>PSO’s</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>
</tr>
<tr>
<td>1</td>
<td>2 3 2 1 1</td>
<td>1 2</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2 2</td>
</tr>
<tr>
<td>3</td>
<td>3 2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>2 2 3</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1 2 2</td>
<td>2</td>
</tr>
<tr>
<td>AVG.</td>
<td>1.8 1.8 3 2 1 1</td>
<td>1.5 1.5 2</td>
</tr>
</tbody>
</table>

TEXT BOOKS:

REFERENCES:
2. Jayanti Natarjan. (2002). Business Process Reengineering, TMH, New Delhi,
CIE335 ENTERPRISE RESOURCE PLANNING

L T P C
3 0 0 3

COURSE OBJECTIVES:
- Describe an idea about ERP.
- Grasp the activities of ERP project management cycle.
- Understanding the emerging trends in ERP developments.
- Creating awareness of core and extended modules of ERP.
- Understand the ERP trending concepts.

UNIT I INTRODUCTION
Overview of enterprise systems – Evolution - Risks and benefits - Fundamental technology - Issues to be consider in planning design and implementation of cross functional integrated ERP systems.

UNIT II ERP SOLUTIONS AND FUNCTIONAL MODULES

UNIT III ERP IMPLEMENTATION

UNIT IV POST IMPLEMENTATION
Maintenance of ERP- Organizational and Industrial impact; Success and Failure factors of ERP Implementation.

UNIT V EMERGING TRENDS ON ERP

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Knowledge of ERP implementation cycle.
CO2: Awareness of core and extended modules of ERP.
CO3: Able to understand ERP implementation steps.
CO4: Able to understand post implementation procedure.
CO5: Able to understand ERP trending concepts.

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>AVg.</td>
<td>2.2</td>
<td>1.6</td>
</tr>
</tbody>
</table>

TEXT BOOK:
REFERENCES:

CIE336 COST ESTIMATION AND CONTROL  L T P C  3 0 0 3

COURSE OBJECTIVES:
- Gaining knowledge in the field of cost estimation.
- Enable the students to estimate the cost of various manufacturing processes.
- Controlling the manufacturing and software cost.
- Designing the cost analysis.
- Applying cost estimation procedures in all types of industries.

UNIT I ESTIMATION AND COSTING  9

UNIT II PRODUCT COST ESTIMATION  9
Estimation in Forging shop–in welding shop –in Foundry Shop –in Machining Shop etc.,

UNIT III SOFTWARE COST ESTIMATION  9

UNIT IV COSTING METHODS  9
Job costing –Operating costing – Process costing.

UNIT V COST ANALYSIS FOR PLANNING AND CONTROL  9
Marginal costing –Standard costing and Variance Analysis–Budgetary control

TOTAL:45 PERIODS

COURSE OUTCOMES:
CO1: To estimate the manufacturing cost and computation of software cost.
CO2: Able to estimate product cost.
CO3: To control the manufacturing and software cost.
CO4: To enable both the costing and estimating procedures for all type of industry.
CO5: Able to perform cost analysis.
## CO's- PO's & PSO's MAPPING

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td><strong>AVG.</strong></td>
<td><strong>2.6</strong></td>
<td><strong>2.3</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td><strong>AVG.</strong></td>
<td><strong>2.6</strong></td>
<td><strong>2.3</strong></td>
</tr>
</tbody>
</table>

### TEXT BOOK:

### REFERENCES:
3. Roger, Pressman S, Software Engineering – A Practitioner’s Approach, Tata McGraw Hill,

### CIE337 SUPPLY CHAIN RISK MANAGEMENT

#### COURSE OBJECTIVES:
- To understand risk management definition & principles in the context of commercial management.
- To understand Risk identification and assessment – techniques and tools & Development and justification of risk-driven management decisions.
- To understand supply chain risk management, vulnerability and develop risk response strategies.
- Developing an understanding of basic principles of Risk management processes, procedures & Risk analysis techniques.
- To understand how implementation of supply chain risk management strategies can be effective by industry based real world case studies and scenarios illustrating macro and micro-level risks, and approaches to their management.

#### UNIT I INTRODUCTION TO RISK MANAGEMENT
9
Concept of risk, definition of risk management, levels of risk management within organization, Relationship of risk to possible losses and gains, Concept of Risk and Uncertainty & the Sources, Concept of Risk in terms of Uncertainty, Probability Effect & Outcome, risk and uncertainty: basic concepts, Risk and uncertainty, origin of risk, Typical risk Parameter, Steps in Defining and Measuring Risk, uncertainties, types of uncertainty

#### UNIT II SOURCES OF RISK
9
UNIT III  SUPPLY CHAIN RISK MANAGEMENT - I

UNIT IV  SUPPLY CHAIN RISK MANAGEMENT - II

UNIT V  SUPPLY CHAIN RISK MANAGEMENT ENABLERS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1. To understand the concept of risk, uncertainty & risk parameters in the context of commercial management.
CO2. To develop a capacity to critically review the principles and applications of risk and vulnerability management in the context of commercial environments.
CO3. Analyze risk assessment and mitigation strategies in specific situations.
CO4. To apply SCOR model for supply chain risk management.
CO5. Describe supply chain risk management strategies to implement and monitor appropriate management techniques relevant to specific situations

CO’s- PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</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>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Avg.</td>
<td>2.4</td>
<td>2.4</td>
<td>2.5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

TEXT BOOKS

REFERENCES

105
CIE338 LOGISTICS MANAGEMENT

L T P C
3 0 0 3

COURSE OBJECTIVES:

- Impart the basic knowledge on the concepts on logistics and distribution.
- Inculcate knowledge in Logistics Process, Planning and Materials Management.
- Teach the principles and activities in warehousing and storage.
- Provide knowledge on modes of transportation and international transport.
- Inculcate knowledge on performance monitoring, outsourcing and ICT application in logistics and distribution.

UNIT I INTRODUCTION

Definition and Scope of Logistics – Functions & objectives – Customer Value Chain – Service Phases and attributes – Value added logistics services – Role of logistics in Competitive strategy – Customer Service

UNIT II DISTRIBUTION CHANNELS AND OUTSOURCING LOGISTICS

Distribution channel structure- channel members, channel strategy, role of logistics and support in distribution channels. Logistics requirements of channel members. Logistics outsourcing — catalysts, benefits, value proposition. Third and fourth party logistics. Selection of service provider.

UNIT III TRANSPORTATION AND PACKAGING


UNIT IV PERFORMANCE MEASUREMENT AND COSTS


UNIT V CURRENT TRENDS


TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Understand the concepts of logistics and distribution
CO2: Effectively gain knowledge in logistics planning
CO3: Apply and analyze various principles and concepts in warehousing and storage
CO4: Effectively design and analyze a system of logistics for freight transport
CO5: Understand the basic concepts in outsourcing, benchmarking and safety in distribution
CO's- PO's & PSO's MAPPING

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>2 1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1 2 2 1</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2 2 2 1</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>2 2 1 2 2</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>1 1 2 1 2</td>
</tr>
<tr>
<td>Avg.</td>
<td>2.6</td>
<td>1.6 2 1 2 2 2</td>
</tr>
</tbody>
</table>

TEXT BOOKS

REFERENCES

CIE339 SYSTEMS ENGINEERING

COURSE OBJECTIVES:
- Illustrate the life cycle phases and framework for systems engineering.
- Describe about systems engineering process.
- Apply ergonomic and system dynamic models for evaluation of alternatives.
- Create knowledge on Reliability, Markov and Time series models for analysis of alternatives.
- Describe about decision assessment methods in systems engineering.

UNIT I INTRODUCTION
Definitions of Systems Engineering, Systems Engineering Knowledge, Life cycles, Life-cycle phases, logical steps of systems engineering, Frame works for systems engineering.
UNIT II  SYSTEMS ENGINEERING PROCESSES  9
Formulation of issues with a case study, Value system design, Functional analysis, Business Process Reengineering, Quality function deployment, System synthesis, Approaches for generation of alternatives.

UNIT III  ANALYSIS OF ALTERNATIVES - I  9
Cross-impact analysis, Structural modeling tools, System Dynamics models with case studies, Economic models: present value analysis – NPV, Benefits and costs over time, ROI, IRR; Work and Cost breakdown structure.

UNIT IV  ANALYSIS OF ALTERNATIVES – II  9
Reliability, Availability, Maintainability, and Supportability models; Stochastic networks and Markov models, Queuing network optimization, Time series and Regression models, Evaluation of large scale models

UNIT V  DECISION ASSESSMENT  9
Decision assessment types, Five types of decision assessment efforts, Utility theory, Group decision making and Voting approaches, Social welfare function; Systems Engineering methods for Systems Engineering Management

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will
CO1: Be able to recognize life cycle phases in systems engineering.
CO2: Apply steps in systems engineering process for large scale problems.
CO3: Able to develop system dynamic models for analyzing alternatives.
CO4: Gain ability to evaluate alternatives in large scale problems.
CO5: Be able Attain confidence in assessment and arrive decisions for complex problems.

CO’s- PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</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>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>3</td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVg.</td>
<td>3</td>
<td>2.6</td>
<td>2.6</td>
<td>2.6</td>
<td>3</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td>2.5</td>
<td>2.2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TEXT BOOK:

REFERENCES:
ME3792        COMPUTER INTEGRATED MANUFACTURING        L   T   P   C
                                                            3   0   0   3

COURSE OBJECTIVES
1. To provide the overview of evolution of automation, CIM and its principles.
2. To learn the various Automation tools, include various material handling system.
3. To train students to apply group technology and FMS.
4. To familiarize the computer aided process planning in manufacturing.
5. To introduce to basics of data transaction, information integration and control of CIM.

UNIT – I       INTRODUCTION        9

UNIT – II       AUTOMATED MANUFACTURING SYSTEMS        9

UNIT – III      GROUP TECHNOLOGY AND FMS        9

UNIT – IV       PROCESS PLANNING        9

UNIT – V       PROCESS CONTROL AND DATA ANALYSIS        9

TOTAL :45 PERIODS
OUTCOMES:
At the end of the course the students would be able to
1. Discuss the basics of computer aided engineering.
2. Choose appropriate automotive tools and material handling systems.
3. Discuss the overview of group technology, FMS and automation identification methods.
4. Design using computer aided process planning for manufacturing of various components
5. Acquire knowledge in computer process control techniques.

TEXT BOOKS:
2. CIM: Computer Integrated Manufacturing: Computer Steered Industry
   Book by August-Wilhelm Scheer

REFERENCES:
1. Alavudeen and Venkateshwaran, Computer Integrated Manufacturing ll, PHI Learning Pvt. Ltd.,
   New Delhi, 2013.
4. Mikell P. Groover, Automation, Production system and Computer integrated Manufacturing,
5. Radhakrishnan P, Subramanian S and Raju V, CAD/CAM/CIM, New Age International Publishers,

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

Low (1) ; Medium (2) ; High (3)

CIE340 FLEXIBLE MANUFACTURING SYSTEMS L T P C
3 0 0 3

COURSE OBJECTIVES:
• To understand the Modern manufacturing systems
• To understand the concepts and applications of flexible manufacturing systems
• To apply the knowledge of FMS simulation
• To understand the concepts of group technology
• To apply the concepts of FMS in modern machining

UNIT I PLANNING, SCHEDULING AND CONTROL OF FLEXIBLE MANUFACTURING SYSTEMS 9
Introduction to FMS - development of manufacturing systems - benefits - major elements of FMS - types of flexibility - FMS application and flexibility – single product, single batch, n - batch scheduling problem - knowledge based scheduling system.
UNIT II  COMPUTER CONTROL AND SOFTWARE FOR FLEXIBLE MANUFACTURING SYSTEMS

Introduction - composition of FMS - hierarchy of computer control - computer control of work center and assembly lines - FMS supervisory computer control - types of software specification and selection - trends.

UNIT III  FMS SIMULATION AND DATABASE


UNIT IV  GROUP TECHNOLOGY AND JUSTIFICATION OF FMS

Introduction - matrix formulation - mathematical programming formulation - graph formulation - knowledge based system for group technology - economic justification of FMS - application of possibility distributions in FMS systems justification.

UNIT V  APPLICATIONS OF FMS AND FACTORY OF THE FUTURE

FMS application in machining, sheet metal fabrication, prismatic component production - aerospace application - FMS development towards factories of the future - artificial intelligence and expert systems in FMS - design philosophy and characteristics for future.

COURSE OUTCOMES:

CO1. Ability to perform Planning, Scheduling and control of FMS
CO2. Demonstrate the software requirements to control the FMS and select a software from various alternatives
CO3. Can perform simulation of FMS and also specify a Database scheme for FMS
CO4. Can classify the parts into part families using group technology

TOTAL: 45 PERIODS

CO’s- PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</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>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>2</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></td>
<td></td>
<td>1</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>3</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>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PO’s</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Avg</td>
<td>2.6</td>
<td>2.3</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PSO’s</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Avg</td>
<td>2.5</td>
<td>1.5</td>
<td>2</td>
</tr>
</tbody>
</table>

TEXT BOOK:

REFERENCES:
CIE341 LEAN AND AGILE MANUFACTURING L T P C
3 0 0 3

COURSE OBJECTIVES:
- To introduce the lean manufacturing and identify the waste.
- To study the various tools for lean manufacturing (LM).
- To apply the above tools to implement LM system in an organization.
- To provide knowledge on perfect value creation process that has zero waste.
- To apply the lean manufacturing tools and techniques through case studies.

UNIT I INTRODUCTION TO LEAN MANUFACTURING 9
Introduction to Lean - Definition, Purpose, features of Lean, tops evenwastes, Need for Lean, Elements of Lean Manufacturing.

UNIT II LEAN MANUFACTURING TOOLS AND METHODOLOGIES 9

UNIT III JUST IN TIME MANUFACTURING, VSM 9
Introduction - Elements of JIT - Uniform production rate - Kanban system - Small lot size - Quick, inexpensive set-up - Continuous improvement. Value stream mapping – Procedure and principles.

UNIT IV AGILE PRODUCTION SYSTEM AND PRACTICES 9
Agile production system – the task aligned organization – agile manufacturing production system – production planning and control, quality assurance, purchasing, maintenance, overview of production support, business operation, engineering, human resource, finance and accounting. Agile practices - Agile practice for product development – manufacturing agile practice – understanding the value of investing in people, removing inappropriate fear from the shop floor – not scarifying agility for perfectionism

UNIT V MANAGEMENT IN THE AGILE ORGANISATION 9
Old management styles, role of manager in an agile organization – vision champion, team leader, coach, business analyzer, supporting the new culture – performance appraisal systems, reward and recognition systems, organizational measurement, organizational learning processes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will be able to:
CO1: Identify the waste in various manufacturing process.
CO2: Understanding principles of cellular manufacturing, JIT and TPM
CO3: Reduce the manufacturing time by applying concepts of TQM, 5S and VSM.
CO4: get knowledge on sixsigmaapproach
CO5: get knowledge on applying the leanmanufacturing tools and techniques

CO's PO's & PSO's MAPPING

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>2.7</td>
</tr>
<tr>
<td>1</td>
<td>2.5</td>
<td></td>
</tr>
</tbody>
</table>

AVG. 2.7 2.7 2.5 1.2 2.5 2.5 2.5
REFERENCES

CIE342 OPERATIONS SCHEDULING

L T P C
3 0 0 3

COURSE OBJECTIVES:
- Define the basic concepts of scheduling theory.
- Illustrate the application of single machine scheduling algorithms.
- Transfer knowledge in parallel machine scheduling algorithms.
- Teach the concept of flow shop scheduling and its algorithm.
- Describe the use of algorithms for job shop scheduling algorithms.

UNIT I SCHEDULING THEORY

UNIT II SINGLE MACHINE SCHEDULING

UNIT III PARALLEL MACHINE SCHEDULING

UNIT IV FLOW SHOP SCHEDULING

UNIT V JOB SHOP SCHEDULING

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Able to understand fundamental concepts of scheduling theory.
CO2: Students will be able to solve single machine sequencing problems with an objective to minimize mean flow time or mean tardiness.
CO3: Students will be able to design a parallel machine schedule which can minimize mean flow time, or make span.

CO4: Students will be able to determine an optimal schedule for a flow shop.

CO5: Students will be able to solve complex job shop problems, design and evaluate various feasible job shop schedules.

### CO’s- PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3 3 3 2 3</td>
<td>2 2 3 1</td>
</tr>
<tr>
<td>2</td>
<td>3 3 2 3 2</td>
<td>2 1 2 3</td>
</tr>
<tr>
<td>3</td>
<td>3 3 3 3 2</td>
<td>2 1 2</td>
</tr>
<tr>
<td>4</td>
<td>3 3 3 2 3</td>
<td>2 1</td>
</tr>
<tr>
<td>5</td>
<td>3 2 3 3 2</td>
<td>2 2</td>
</tr>
<tr>
<td>AVG.</td>
<td>3 2.6 2.6 2.6 2.4</td>
<td>2 1.4 2 2.6 2</td>
</tr>
</tbody>
</table>

### TEXT BOOK:

### REFERENCE:

### CIE343 MODELLING OF MANUFACTURING SYSTEMS

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>L T P C</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIE343</td>
<td>MODELLING OF MANUFACTURING SYSTEMS</td>
<td>3 0 0 3</td>
</tr>
</tbody>
</table>

### COURSE OBJECTIVES:
To introduce the students different models used to describe the manufacturing systems and use of them for effective operations of manufacturing industries.

**UNIT I** INTRODUCTION

Manufacturing systems types and concepts, manufacturing automation, performance measures types, classification and uses of manufacturing system models FMS planning and scheduling – Part selection and loading problems.

**UNIT II** FOCUSED FACTORIES

Focused flow lines – Work cells- work centers, Group technology, General serial systems – Analysis of paced and unpaced lines, system effectiveness, impact of random processing times

**UNIT III** MARKOV MODELS

Stochastic processes in manufacturing, Markov chain models – DTMC and CTMC, steady state analysis, Transient Analysis of Manufacturing Systems

**UNIT IV** QUEUING MODELS OF MANUFACTURING

Basic queuing models, Queuing networks in manufacturing – Jackson and Gordon Newell, product form solution

**UNIT V** PETRINET MODEL


TOTAL : 45 PERIODS
COURSE OUTCOMES:
CO1. Can evaluate a given automated manufacturing system based on performance measures
CO2. Can apply group technology concepts to form Machine cells
CO3. Can model the Assembly line using Markov, Queuing and Petri Net model
CO4. Can analyze and model production lines using Markov, Queuing and Petri Net model

CO’s- PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO</th>
<th>PO’s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Avg</td>
<td>2.6</td>
<td>2.2</td>
</tr>
</tbody>
</table>

REFERENCES:

CIE344 ADVANCED OPTIMIZATION TECHNIQUES L T P C
3 0 0 3

COURSE OBJECTIVES:
- Learn to solve integer programming problems
- To know how to solve the Dynamic programming problems
- Learn to solve non-linear programming problems with un constrained optimization problems
- Understand to solve non-linear programming problems using KKT conditions, quadratic and separable programming
- To create awareness of Meta heuristic algorithms.

UNIT I INTEGER PROGRAMMING

UNIT II DYNAMIC PROGRAMMING

UNIT III NONLINEAR PROGRAMMING - I
Types of Nonlinear Programming Problems - One-Variable Unconstrained Optimization - Multivariable Unconstrained Optimization
UNIT IV NONLINEAR PROGRAMMING – II
The Karush-Kuhn-Tucker (KKT) Conditions for Constrained Optimization - Quadratic Programming
- Separable Programming - Convex Programming - Nonconvex Programming

UNIT V NON-TRADITIONAL OPTIMIZATION

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Know how to solve integer programming problems
CO2: Able to solve Dynamic programming problems
CO3: Familiar in solving unconstrained non-linear optimization problems
CO4: Familiar in solving constrained liner optimization problems
CO5: Know how to solve non-linear optimization problems using Meta heuristic algorithms

CO’s- PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3 2 3</td>
<td>2 2</td>
</tr>
<tr>
<td>2</td>
<td>3 2 2</td>
<td>3 1</td>
</tr>
<tr>
<td>3</td>
<td>2 3 3</td>
<td>1 1</td>
</tr>
<tr>
<td>4</td>
<td>3 2 2</td>
<td>1 1</td>
</tr>
<tr>
<td>5</td>
<td>3 2 3</td>
<td>2 1</td>
</tr>
<tr>
<td>AVG.</td>
<td>3 2 3</td>
<td>2 1</td>
</tr>
</tbody>
</table>

REFERENCES:

ME3592 METROLOGY AND MEASUREMENTS

COURSE OBJECTIVES
1. To learn basic concepts of the metrology and importance of measurements.
2. To teach measurement of linear and angular dimensions assembly and transmission elements.
3. To study the tolerance analysis in manufacturing.
4. To develop the fundamentals of GD & T and surface metrology.
5. To provide the knowledge of the advanced measurements for quality control in manufacturing industries.
UNIT – I  BASICS OF METROLOGY  

UNIT – II  MEASUREMENT OF LINEAR, ANGULAR DIMENSIONS, ASSEMBLY AND TRANSMISSION ELEMENTS

UNIT – III  TOLERANCE ANALYSIS
Tolerancing– Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables IS919); Design of Limit gauges, Problems. Tolerance analysis in manufacturing, Process capability, tolerance stackup, tolerance charting.

UNIT – IV  METROLOGY OF SURFACES
Fundamentals of GD & T- Conventional vs Geometric tolerance, Datums, Inspection of geometric deviations like straightness, flatness, roundness deviations; Simple problems – Measurement of Surface finish – Functionality of surfaces, Parameters, Comparative, Stylus based and Optical Measurement techniques, Filters, Introduction to 3D surface metrology- Parameters.

UNIT – V  ADVANCES IN METROLOGY

OUTCOMES: At the end of the course the students would be able to
1. Discuss the concepts of measurements to apply in various metrological instruments.
2. Apply the principle and applications of linear and angular measuring instruments, assembly and transmission elements.
3. Apply the tolerance symbols and tolerance analysis for industrial applications.
4. Apply the principles and methods of form and surface metrology.
5. Apply the advances in measurements for quality control in manufacturing Industries.

TEXT BOOKS:

REFERENCES:
CIE345   QUALITY ASSURANCE AND AUDITING   L T P C

COURSE OBJECTIVES:
- To understand the objectives and Importance of Quality Management.
- To analyze the phases of audit and audit plan.
- To learn about the role of Information Technology in Quality improvement.
- To prepare the formal report.

UNIT I   INTRODUCTION

UNIT II   QUALITY IMPROVEMENT TECHNIQUES
Continuous process improvement - The Juran Trilogy - Improvement strategies - The PDSA Cycle - Kaizen - Six- Sigma - Bench Marking – Cost of Quality – Quality function Deployment - The role of Information Technology in Quality improvement

UNIT III   INTRODUCTION

UNIT IV   AUDIT PROGRAM MANAGER AND PREPARATION
Accountability – Resources for audit program – Phases of audit – The audit team – Second rule of auditing – Authority – Requirements – Understand the process – Audit Plan – Evaluate documents

UNIT V   PERFORMANCE AND REPORTING
Corrective action response – Adequacy of the response – Records – An Example Procedure - the process approach – Auditing process-based Quality Management System – Audit program management – The process of Auditing – Audit reporting phase – Audit closure phase

COURSE OUTCOMES:
CO1: Distinguish between the product quality and service quality.
CO2: Analyze the model of auditing.
CO3: Evaluate the documents for audit plan
CO4: Analyze the Corrective action response and adequacy of the response
CO5: Apply the process of auditing

REFERENCES

MAPPING OF COS AND POS:

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>AVg.</td>
<td>2.4</td>
<td>2.3</td>
</tr>
</tbody>
</table>

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
- Explaining the fundamental concept and principles of industrial safety
- Applying the principles of maintenance engineering.
- Analyzing the wear and its reduction.
- Evaluating faults in various tools, equipments and machines.
- Applying periodic maintenance procedures in preventive maintenance

UNIT I INDUSTRIAL SAFETY
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, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods

119
UNIT II 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, the Service life of the 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, shown as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment like i. Any one machine tool, ii. Pump iii. Air compressor, iv. The 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

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: Explain the fundamental concept and principles of industrial safety
CO2: Apply the principles of maintenance engineering.
CO3: Analyze the wear and its reduction.
CO4: Evaluate faults in various tools, equipments and machines.
CO5: Apply periodic maintenance procedures in preventive maintenance.

TOTAL: 45 PERIODS

REFERENCES:
COURSE OBJECTIVES:
- Impart knowledge on principles and steps in designing a statistically designed experiment.
- Build foundation in analysing the data in single factor experiments and to perform post hoc tests.
- Provide knowledge on analysing the data in factorial experiments.
- Educate on analysing the data analysis in special experimental designs and Response Surface Methods.
- Impart knowledge in designing and analysing the data in Taguchi's Design of Experiments to improve Process/Product quality.

UNIT I  FUNDAMENTALS OF EXPERIMENTAL DESIGNS  9
Hypothesis testing – single mean, two means, dependant/ correlated samples – confidence intervals, Experimentation – need, Conventional test strategies, F-test, terminology, basic principles of design, steps in experimentation – choice of sample size – Normal and half normal probability plot – simple linear and multiple linear regression, Analysis of variance.

UNIT II  SINGLE FACTOR EXPERIMENTS  9

UNIT III  FACTORIAL DESIGNS  9
Main and Interaction effects - Two and three factor full factorial designs- Fixed effects and random effects model - Rule for sum of squares and Expected Mean Squares- 2 K Design with two and three factors- Yate's Algorithm- fitting regression model- Randomized Block Factorial Design.

UNIT IV  SPECIAL FACTORIAL DESIGNS  9

UNIT V  TAGUCHI METHODS  9
Design of experiments using Orthogonal Arrays, Data analysis from Orthogonal Experiments Response Graph Method, ANOVA- Attribute data analysis- Robust design- noise factors, Signal to Noise ratios, Inner/outer OA design- case studies.

TOTAL: 45 PERIODS

121
COURSE OUTCOMES:
CO1: Understand the fundamental principles of Design of Experiments.
CO2: Analyze data in the single factor experiments.
CO3: Analyze data in the multifactor experiments.
CO4: Understand the special experimental designs & Response Surface Methods.
CO5: Apply Taguchi based approach to evaluate quality.

TEXT BOOKS

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</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>
</tr>
<tr>
<td>1</td>
<td>3 3 2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3 3 3 2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3 3 2 3 3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3 2 3 3 3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>2 3 2 2 3</td>
<td>3 3 2</td>
</tr>
<tr>
<td>AVg.</td>
<td>2.8 2.8 2.4 2.5 3</td>
<td>3 3</td>
</tr>
</tbody>
</table>

CIE348 RELIABILITY ENGINEERING

COURSE OBJECTIVES:
- Impart knowledge in reliability concepts
- Facilitate students in filling the life data into theoretical distribution.
- Educate the students in reliability evaluation of various configuration.
- Impart knowledge in reliability monitoring methods.
- Analyze effectively various techniques to improve reliability of the system.

UNIT I RELIABILITY CONCEPT 9
Reliability definition – , Reliability parameters- f(t), F(t,) and R(t) functions- Measures of central tendency Bathub curve – A priori and posterior probabilities of failure – Component mortality - Useful life.

UNIT II LIFE DATA ANALYSIS 9

UNIT III RELIABILITY ESTIMATION 9
Series parallel configurations – Parallel redundancy – m/n system – Complex systems: RBD approach – Baye’s method – Minimal path and cut sets - Fault Tree analysis – Standby system.

UNIT IV RELIABILITY MANAGEMENT 9
UNIT V  RELIABILITY IMPROVEMENT  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Understand the basic concepts of reliability engineering
CO2: Effectively analyze various non parametric methods and failure distributions
CO3: Conduct reliability assessment and failure analysis on any complex systems
CO4: Effectively design and analyze reliability monitoring techniques
CO5: Analyze various techniques to improve reliability of the system

TEXT BOOK:

REFERENCE:

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</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>
</tr>
<tr>
<td>1</td>
<td>2 3 2 1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3 3 3 3</td>
<td>2 3</td>
</tr>
<tr>
<td>3</td>
<td>3 3 3 3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3 2 2 3 3</td>
<td>2 3</td>
</tr>
<tr>
<td>5</td>
<td>3 3 2 2</td>
<td>2 3</td>
</tr>
<tr>
<td>Avg.</td>
<td>2.8 3 2.4 2 2.5</td>
<td>2 2 3</td>
</tr>
</tbody>
</table>

CIE349  ADVANCED MEASUREMENT SYSTEM  L T P C  3 0 0 3

COURSE OBJECTIVES:
- Describe the principles of engineering tribology.
- Summarize the metrology of surface finish.
- Relate computer in measurement / industrial inspection systems.
- Contrast the corrosion types and its testing methods.
- Describe the principle and standards of destructive and non destructive testing.

UNIT I  FRICTION AND WEAR MEASUREMENT  9

UNIT II  SURFACE FINISH &VIDEO MEASUREMENT SYSTEMS  9
UNIT III  COMPUTER-AIDED METROLOGY  9

UNIT IV  MEASUREMENT OF CORROSION  9
Introduction – types- definition and principles. Purpose of corrosion testing - corrosion testing equipment – susceptibility tests for intergranular corrosion - Stress corrosion test. Salt spray test humidity and porosity tests accelerated weathering tests. ASTM standards for corrosion testing.

UNIT V  DESTRUCTIVE AND NON DESTRUCTIVE TESTING  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course the students will be able to learn about:
CO1: The principles of engineering tribology and the procedures for performing tribological tests.
CO2: The fundamentals of metrology of surface finish.
CO3: The applications of computer in measurement/inspection system.
CO4: The various types of corrosion, effects and testing methods.
CO5: The principles and procedure of destructive and non destructive testing

REFERENCES:

<table>
<thead>
<tr>
<th>CO’s</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>3</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>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</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>3</td>
<td>3</td>
<td></td>
<td>3</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>4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</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>5</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVg.</td>
<td>3</td>
<td>2.6</td>
<td>2.6</td>
<td>2.8</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CIE350 LEAN SIX SIGMA L T P C 3 0 0 3

COURSE OBJECTIVES:
- Explain the basics of Lean and Six Sigma.
- Teach the need and the process of integrating Lean and Six sigma.
- Summarize to identify and select the resources required for LSS Projects and selection of projects including Team building.
- Teach the DMAIC process and study the various tools for undertaking LSS projects.
- Illustrate to institutionalize the LSS efforts

UNIT I INTRODUCTION TO LEAN AND SIX SIGMA 9
Introduction to Lean- Definition, Purpose, Features of Lean; Top seven wastes, need for Lean management, the philosophy of lean management, Creating a lean enterprise, Elements of Lean, Lean principles, the lean metric, Hidden time traps. Introduction to quality, Definition of six sigma, origin of six sigma, Six sigma concept and Critical success factors for six sigma.

UNIT II INTEGRATION OF LEAN AND SIX SIGMA 9
Evolution of lean six sigma, the synergy of Lean and six sigma, Definition of lean six sigma, the principles of lean six sigma, Scope for lean six sigma, Features of lean six sigma. The laws of lean six sigma, Key elements of LSS, the LSS model and the benefits of lean six sigma. Initiation - Top management commitment – Infrastructure and deployment planning, Process focus, organizational structures, Measures – Rewards and recognition, Infrastructure tools, the structure of transforming event and Launch preparation.

UNIT III PROJECT SELECTION AND TEAM BUILDING 9
Resource and project selection, Selection of Black belts, Training of Black belts and Champions, Identification of potential projects, top down (Balanced score card) and Bottom up approach – Methods of selecting projects – Benefit/Effort graph, Process mapping, value stream mapping, Predicting and improving team performance, Nine team roles and Team leadership.

UNIT IV THE DMAIC PROCESS AND TOOLS 9
The DMAIC process – Toll gate reviews; The DMAIC tools; Define tools – Project definition form, SIPOC diagram; Measure tools – Process mapping, Lead time/cycle time, Cause and Effect matrix, Idea – generating and organizing tools – Brainstorming, Nominal group technique and Multi-voting; Data collection and accuracy tools- Check sheet, Gauge R&R; Understanding and eliminating variation– run charts; Analyze tools - Scatter plots, ANOVA, Regression analysis, Time trap analysis; Improve tools – Mistake proofing, Set up time reduction (SMED) and the pull system; Control tools – statistical process control.

UNIT V INSTITUTIONALIZING AND DESIGN FOR LSS 9
Institutionalizing lean six sigma – improving design velocity, creating cycle time base line, valuing projects, gating the projects, reducing product line complexity, Design for lean six sigma, QFD, Theory of Inventive Problem solving (TRIZ), Robust design; Case study presentations

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: The students will be able to understand what is Lean and Six sigma and their importance in the globalized competitive world.
CO2: The students will be able to understand the importance of integrating Lean and Six sigma and also the process of their integration.
CO3: The students will be able to plan the Resources required to undertake the LSS projects and also acquire how to select the suitable projects and the teams.

CO4: The students will be able apply DMAIC methodology to execute LSS projects and in this regard they will be acquainted with various LSS tools.

CO5: The students will be able to understand the process of institutionalizing the LSS effort and also understand the Design for LSS.

REFERENCES:

MAPPING OF COS AND POS:

<table>
<thead>
<tr>
<th>CO's</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>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td>3</td>
<td>3</td>
<td>2.5</td>
<td>2.5</td>
</tr>
<tr>
<td>AVg.</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2.6</td>
</tr>
</tbody>
</table>

CIE351 MULTIVARIATE DATA ANALYSIS

COURSE OBJECTIVES:
- To impart knowledge on the Regression
- To understand the concepts of multivariate method
- To apply the knowledge of factor analysis
- To apply the knowledge of discriminant analysis
- To apply the knowledge of cluster analysis

UNIT I MULTIVARIATE METHODS
An overview of Multivariate methods, Multivariate Normal distribution, Eigen values and Eigen vectors.

UNIT II REGRESSION
Simple Regression and Correlation – Estimation using the regression line, Correlation analysis, Multiple regression and Correlation analysis – Finding the Multiple Regression equation, Modelling techniques, Making inferences about the population parameters.

UNIT III FACTOR ANALYSIS
Principal Component Analysis – COURSE OBJECTIVES, Estimation of principal components, Testing for the independence of variables, Factor analysis model – Factor analysis equations and solution – Exploratory Factor analysis – Confirmatory Factor analysis.
UNIT IV  DISCRIMINANT ANALYSIS  9

UNIT V  CLUSTER ANALYSIS  9
Cluster analysis – Clustering methods, Multivariate analysis of Variance

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: Can apply the multivariate, analysis techniques for statistical analysis
CO2: Can apply the regression, analysis techniques for statistical analysis
CO3: Can apply the factor, analysis techniques for statistical analysis
CO4: Can apply the discriminant analysis techniques for statistical analysis
CO5: Can apply the cluster analysis techniques for statistical analysis

REFERENCES:

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2 2 3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>2 3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>2 3</td>
<td>3 2</td>
</tr>
<tr>
<td>AVg.</td>
<td>3 2.3</td>
<td>3 3</td>
</tr>
</tbody>
</table>

CIE365  DATABASE MANAGEMENT SYSTEM  L T P C

3 0 0 3

COURSE OBJECTIVES:
- To understand the fundamentals of data models and conceptualize and depict a database system using ER diagram.
- To make a study of SQL and relational database design.
- To know about data storage techniques and query processing.
- To impart knowledge in transaction processing, concurrency control techniques and recovery procedures.

UNIT I  RELATIONAL MODEL  9

UNIT II  PARALLEL AND DISTRIBUTED DATABASES  9
UNIT III    XML DATABASES XML
Open Database Connectivity.

UNIT IV    MULTIMEDIA DATABASES
Databases – Audio Databases – Multimedia Database Design.

UNIT V    CURRENT ISSUES ACTIVE
Databases – Deductive Databases – Data Warehousing – Data Mining – Database Tuning –
Database Security.

TOTAL:45 PERIODS

COURSE OUTCOMES:

- Upon Completion of the course, the students will be able to Understand the basic
  concepts of the database and data models.
- Design a database using ER diagrams and map ER into Relations and normalize the
  relations
- Acquire the knowledge of query evaluation to monitor the performance of the DBMS.
- Develop a simple database applications using normalization.
- Acquire the knowledge about different special purpose databases and to critique how
  they differ from traditional database systems.

REFERENCES:
1. R. Elmasri, S.B. Navathe, —Fundamentals of Database SystemsII, Addison-Wesley,
   2011.
2. Thomas Cannolly and Carolyn Begg, —Database Systems, A Practical Approach to
3. Henry F Korth, Abraham Silberschatz, S. Sudharshan, —Database System ConceptsII,
4. C.J.Date, A.Kannan and S.Swamynathan, IIAn Introduction to Database Systemse, Eighth

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Avg.</td>
<td>3</td>
<td>2.2</td>
</tr>
</tbody>
</table>

128
COURSE OBJECTIVES:
- To understand and apply the algorithm analysis techniques.
- To critically analyze the efficiency of alternative algorithmic solutions for the same problem.
- To understand different algorithm design techniques.
- To understand the limitations of Algorithmic power.

UNIT I  ANALYSING ALGORITHMS  9

UNIT II  DIVIDE AND CONQUER & GREEDY DESIGN STRATEGIES  9

UNIT III  DYNAMIC PROGRAMMING AND OTHER DESIGN STRATEGIES  9

UNIT IV  FLOW NETWORKS AND STRING MATCHING  9

UNIT V  NP PROBLEMS  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- Design algorithms for various computing problems.
- Analyze the time and space complexity of algorithms.
- Critically analyze the different algorithm design techniques for a given problem.
- Modify existing algorithms to improve efficiency.
- Analyze the concepts of NP problems

REFERENCES:

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Avg</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

CIE353 SOFTWARE COST ESTIMATION

COURSE OBJECTIVES:
- To understand the Objectives and Importance of Software cost estimation.
- To analyze the requirement engineering techniques and models.
- To provide a good understanding of size estimation and measurements.
- To evaluate the tool for database estimation and algebraic model
- To provide a good understanding of software estimation

UNIT I INTRODUCTION
Introduction to software requirements- Estimation, Software engineering, software lifecycle- software project-management activities-requirements engineering-software estimation

UNIT II REQUIREMENT ENGINEERING
Requirement elicitation-techniques-analysis-models-documentation-review-management

UNIT III SIZE ESTIMATION
Tutorial & sizing-FAP-MARKII FPA-Full FP-FP Extensions-computations-functional size measurement-LOC estimation- conversion between size measures-sizing for conversion and maintenance.

UNIT IV EFFORT SCHEDULE AND COST ESTIMATION
Estimation Factors-Rayleigh curve-effort and schedule estimation- Mark II FP estimation-COCOMO II-COCOMO 81-algebraic models-analogy-bottom-up cost- validity software estimates.

UNIT V SOFTWARE ESTIMATES
Database & tools for estimation- database for requirements-estimation-model calibration-desirable features in software estimation tools-some software estimation tools

COURSE OUTCOMES:
CO1: Understanding the COURSE OBJECTIVES and Importance of Software cost estimation.
CO2: Analyzing the requirement engineering techniques and models.
CO3: Providing a good understanding of size estimation and measurements.
CO4: Evaluating the tool for database estimation and algebraic model
CO5: Providing a good understanding of software estimation

TEXT BOOKS:

MAPPING OF COS AND POS:

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Avg.</td>
<td>2.2</td>
<td>2.4</td>
</tr>
</tbody>
</table>

CIE354 AGILE SOFTWARE DEVELOPMENT

COURSE OBJECTIVES:
- To provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software.
- To provide a good understanding of software design and a set of software technologies and APIs.
- To do a detailed examination and demonstration of Agile development and testing techniques.
- To understand the benefits and pitfalls of working in an Agile team.
- To understand Agile development and testing.

UNIT I AGILE METHODOLOGY
Theories for Agile management – agile software development – traditional model vs. agile model - classification of agile methods – agile manifesto and principles – agile project management – agile team interactions – ethics in agile teams - agility in design, testing – agile documentations – agile drivers, capabilities and values.

UNIT II AGILE PROCESSES

UNIT III AGILITY AND KNOWLEDGE MANAGEMENT
UNIT IV    AGILITY AND REQUIREMENTS ENGINEERING

UNIT V    AGILITY AND QUALITY ASSURANCE

COURSE OUTCOMES:
Upon completion of the course, the students will be able to:
CO1: Realize the importance of interacting with business stakeholders in determining the requirements for a software system
CO2: Perform iterative software development processes: how to plan them, how to execute them.
CO3: Point out the impact of social aspects on software development success.
CO4: Develop techniques and tools for improving team collaboration and software quality. Perform Software process improvement as an ongoing task for development teams
CO5: Show how agile approaches can be scaled up to the enterprise level.

TEXT BOOKS:

REFERENCES:
4. Craig Larman, —Agile and Iterative Development: A manager’s Guidell, Addison-Wesley, 2004

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>AVg.</td>
<td>2.4</td>
<td>2.2</td>
</tr>
</tbody>
</table>
CIE355 SOFTWARE QUALITY MANAGEMENT

COURSE OBJECTIVES:
- Studying the basic principles and concepts in software quality
- Effectively designing, analyzing and developing the software engineering activities
- Gaining knowledge on software quality assurance and risk management
- Analyze the principles and applications of software quality management tools
- Gaining knowledge about software quality standards

UNIT I INTRODUCTION 9

UNIT II SOFTWARE METRICS 9
Goal, Question, Metric (GQM) model, Product Quality metrics, In-process Quality metrics, Metrics for software maintenance and testing, Complexity Metrics.

UNIT III SOFTWARE PROJECT ESTIMATION 9

UNIT IV SOFTWARE QUALITY 9

UNIT V SOFTWARE QUALITY ASSURANCE 9

TOTAL:45 PERIODS

COURSE OUTCOMES:
CO1 – understand the basic principles and concepts in software quality
CO2 – effectively design, analyze and develop software engineering activities
CO3 – gain knowledge on software quality assurance and risk management
CO4 – understand the principles and applications of software quality management tools
CO5 – gain knowledge about software quality standards

TEXT BOOKS

REFERENCES

<table>
<thead>
<tr>
<th>CO’s</th>
<th>P O ’ s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3</td>
<td>4  5  6</td>
</tr>
<tr>
<td>1</td>
<td>3  2  2</td>
<td>2  2  2</td>
</tr>
</tbody>
</table>
CIE356 SOFTWARE TESTING

L T P C
3 0 0 3

COURSE OBJECTIVES:
- To learn the criteria for test cases.
- To learn the design of test cases.
- To understand test management and test automation techniques.
- To apply test metrics and measurements.

UNIT I INTRODUCTION
9

UNIT II TESTING METHODOLOGIES
9

UNIT III TEST STRATEGIES
9

UNIT IV TEST AUTOMATION AND MANAGEMENT
9

UNIT V SQA IN PROJECT MANAGEMENT
9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- CO1: Design test cases suitable for a software development for different domains.
- CO2: Identify suitable tests to be carried out.
- CO3: Prepare test planning based on the document.
- CO4: Document test plans and test cases designed.
- CO5: Use automatic testing tools.
- CO6: Develop and validate a test plan.
TEXT BOOKS:

REFERENCES

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3</td>
<td>4 5 6</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>AVg.</td>
<td>2.5</td>
<td>2.3</td>
</tr>
</tbody>
</table>

CIE357 SOFTWARE METRICS AND QUALITY AUDIT

COURSE OBJECTIVES:
- To help the students gain understanding of the modeling and testing reliability metrics.
- To provide the knowledge in the prediction of software reliability.
- To enable them to analyze and understand the measurements in software engineering.
- To analyze the phases of audit and audit plan.
- To prepare the formal report.

UNIT I INTRODUCTION TO SOFTWARE RELIABILITY

UNIT II SOFTWARE RELIABILITY MODELING CONCEPT
General Model Characteristic – Historical Development of models – Model Classification scheme – Markovian models – General concepts – General Poisson Type Models – Binomial Type Models – Poisson Type models – Fault reduction factor for Poisson Type models.
UNIT III  COMPARISON OF SOFTWARE RELIABILITY MODELS  

UNIT IV  INTRODUCTION TO AUDIT  

UNIT V  AUDIT PROGRAM MANAGER AND PREPARATION  
Accountability – Resources for audit program – Phases of audit – The audit team – Second rule of auditing – Authority – Requirements – Understand the process – Audit Plan – Evaluate documents

COURSE OBJECTIVES
CO1: Helping the students gain understanding of the modeling and testing reliability metrics.
CO2: Providing the knowledge in the prediction of software reliability.
CO3: Enable them to analyze and understand the measurements in software engineering.
CO4: Analyze the phases of audit and audit plan.
CO5: Preparing the formal report

REFERENCES:

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>AVg.</strong></td>
<td><strong>2.5</strong></td>
<td><strong>2.6</strong></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

UNIT II  ESSENTIALS OF BUSINESS ANALYTICS

UNIT III  MODELING UNCERTAINTY AND STATISTICAL INFERENCE

UNIT IV  ANALYTICS USING HADOOP AND MAPREDUCEFRAMEWORK

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.

COURSE OUTCOMES:
On completion of the course, the student will be able to:
- CO1: Identify the real world business problems and model with analytical solutions.
- CO2: Solve analytical problem with relevant mathematics background knowledge.
- CO3: Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- CO4: Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
- CO5: Use open source frameworks for modeling and storing data.

REFERENCE:
1. Jiawei Han, MichelineKamber, —Data Mining: Concepts and Techniques‖, Morgan Kaufmann, Third edition, 2011.
COURSE OBJECTIVES:
1. To understand the concepts of measurement technology.
2. To learn the various sensors used to measure various physical parameters.
3. To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development
4. To learn about the optical, pressure and temperature sensor
5. To understand the signal conditioning and DAQ systems

UNIT I  INTRODUCTION

UNIT II  MOTION, PROXIMITY AND RANGING SENSORS

UNIT III  FORCE, MAGNETIC AND HEADING SENSORS

UNIT IV  OPTICAL, PRESSURE AND TEMPERATURE SENSORS

UNIT V  SIGNAL CONDITIONING AND DAQ SYSTEMS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Recognize with various calibration techniques and signal types for sensors.
CO2: Describe the working principle and characteristics of force, magnetic, heading, pressure and temperature, smart and other sensors and transducers.
CO3: Apply the various sensors and transducers in various applications.
CO4: Select the appropriate sensor for different applications.
CO5: Acquire the signals from different sensors using Data acquisition systems.

TEXT BOOKS:

REFERENCES

Mapping of COs with POs and PSOs

<table>
<thead>
<tr>
<th>COs/POs &amp; PSOs</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>CO1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO/PO &amp; PSO</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2.2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2.2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 – Slight, 2 – Moderate, 3 – Substantial

MR3392 ELECTRICAL DRIVES AND ACTUATORS L T P C
3 0 0 3

COURSE OBJECTIVES:
1. To familiarize a relay and power semiconductor devices
2. To get a knowledge on drive characteristics
3. To obtain the knowledge on DC motors and drives.
4. To obtain the knowledge on AC motors and drives.
5. To obtain the knowledge on Stepper and Servo motor.

UNIT – I RELAY AND POWER SEMI-CONDUCTOR DEVICES
Study of Switching Devices – Relay and Types, Switching characteristics -BJT, SCR, TRIAC, GTO, MOSFET, IGBT and IGCT-: SCR, MOSFET and IGBT - Triggering and commutation circuit - Introduction to Driver and snubber circuits
UNIT – II  DRIVE CHARACTERISTICS  9

UNIT – III  DC MOTORS AND DRIVES  9
DC Servomotor - Types of PMDC & BLDC motors - principle of operation- emf and torque equations - characteristics and control – Drives- H bridge - Single and Three Phases – 4 quadrant operation – Applications

UNIT – IV  AC MOTORS AND DRIVES  9

UNIT – V  STEPPER AND SERVO MOTOR  9

TOTAL: 45 PERIODS

COURSE OUTCOMES
At the end of the course, the student able to:
CO 1: Recognize the principles and working of relays, drives and motors.
CO 2: Explain the working and characteristics of various drives and motors.
CO 3: Apply the solid state switching circuits to operate various types of Motors and Drivers
CO 4: Interpret the performance of Motors and Drives.
CO 5: Suggest the Motors and Drivers for given applications.

MAPPING OF COS WITH POS AND PSO:

<table>
<thead>
<tr>
<th>COs/Pos&amp;PSOs</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>CO1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO/PO &amp; PSO Average</td>
<td>3</td>
<td>1</td>
<td>1.4</td>
<td>2</td>
<td>1.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TEXT BOOKS:

REFERENCES
COURSE OBJECTIVES:
1. To familiarize the architecture and fundamental units of microcontroller.
2. To know the microcontroller programming methodology and to acquire the interfacing skills and data exchange methods using various communication protocols.
3. To design the interface circuit and programming of I/O devices, sensors and actuators.
4. To understand ARM processor architecture and its functions to meet out the computational and interface needs of growing mechatronic systems.
5. To acquaint the knowledge of real time embedded operating system for advanced system developments.

UNIT I INTRODUCTION TO MICROCONTROLLER

UNIT II PROGRAMMING AND COMMUNICATION

UNIT III PERIPHERAL INTERFACING
I/O Programming – Interfacing of Memory, Key Board and Displays – Alphanumeric and Graphic, RTC, interfacing of ADC and DAC, Sensors - Relays - Solenoid Valve and Heater - Stepper Motors, DC Motors - PWM Programming – Closed Loop Control Programming of Servomotor – Traffic Light

UNIT IV ARM PROCESSOR

UNIT V SINGLE BOARD COMPUTERS AND PROGRAMMING

EMBEDDED SYSTEMS LAB

LIST OF EXPERIMENTS
1. Assembly Language Programming and Simulation of 8051.
2. Alphanumeric and Graphic LCD Interfacing using 8051 Microcontroller.
3. Input switches and keyboard interfacing of 8051.
4. Sensor Interfacing with ADC to 8051 and DAC & RTC Interfacing with 8051.
5. Timer, Counter and Interrupt Program Application for 8051.
6. Step Motor (Unipolar & Bipolar Motor) and PWM Servo Motor Control to Interfacing with 8051.
7. UART Serial and Parallel Port Programming of 8051.
8. I²C, SPI and CAN Programming of 8051.
9. Interfacing and Programming of Bluetooth and Wi-Fi with 8051
15. IOT application using SBC.

(any 7 experiments) TOTAL:30 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO 1: Know the various functional units of microcontroller, processors and system-on-chip based on the features and specifications.
CO 2: Recognize the role of each functional units in microcontroller, processors and system-on-chip based on the features and specifications.
CO 3: Interface the sensors, actuators and other I/O’s with microcontroller, processors and system on chip based interfacing.
CO 4: Design the circuit and write the programming microcontroller, processors and system on chip.
CO 5: Develop the applications using Embedded system.

TEXT BOOKS:

REFERENCES:

<table>
<thead>
<tr>
<th>COs/POs &amp; PSOs</th>
<th>POs</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
</tr>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO/PO &amp; PSO</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 – Slight, 2 – Moderate, 3 – Substantial
COURSE OBJECTIVES:
1. To learn about basics of robots and their classifications
2. To understand the robot kinematics in various planar mechanisms
3. To learn about the concepts in robot dynamics
4. To understand the concepts in trajectory planning and programming
5. To know about the various applications of robots

UNIT – I  BASICS OF ROBOTICS  8

UNIT – II  ROBOT KINMEATICS  11
Robot kinematics: Introduction- Matrix representation- rigid motion & homogeneous transformation- D-H, forward & inverse kinematics of 2DOF and 3 DOF planar and spatial mechanisms

UNIT – III  ROBOT DYNAMICS  9
Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation

UNIT – IV  TRAJECTORY, PATH PLANNING AND PROGRAMMING  8
Trajectory Planning- Joint space and Cartesian space technique, Introduction to robot control, Robot programming and Languages- Introduction to ROS

UNIT – V  ROBOT AND ROBOT APPLICATIONS  9

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, the students can able to
CO1: State the basic concepts and terminologies of robots
CO2: Know the Procedures for Forward and Inverse Kinematics, Dynamics for Various Robots
CO3: Derive the Forward and Inverse Kinematics, Dynamics for Various Robots
CO4: Apply the various programming techniques in industrial applications
CO5: Analyze the use of various types of robots in different applications

<table>
<thead>
<tr>
<th>COs/POs&amp;P</th>
<th>POs</th>
<th>PSOs</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOs</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO/PO &amp; PSO Average</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

1 – Slight, 2 – Moderate, 3 – Substantial
TEXT BOOKS:

REFERENCES:

CMR338 SMART MOBILITY AND INTELLIGENT VEHICLES

COURSE OBJECTIVES:
The objectives of the course are:
1. To introduce students to the various technologies and systems used to implement smart mobility and intelligent vehicles.
2. To learn Basics of Radar Technology and Systems, Ultrasonic Sonar Systems, LIDAR Sensor Technology and Systems and other sensors for automobile vision system.
3. To learn Basic Control System Theory applied to Autonomous Automobiles.
4. To produce overall impact of automating like various driving functions, connecting the automobile to sources of information that assist with a task
5. To allow the automobile to make autonomous intelligent decisions concerning future actions of the vehicle that potentially impact the safety of the occupants through connected car & autonomous vehicle technology.

UNIT – I INTRODUCTION TO AUTOMATED, CONNECTED, AND INTELLIGENT VEHICLES
Concept of Automotive Electronics, Electronics Overview, History & Evolution, Infotainment, Body, Chassis, and Powertrain Electronics, Introduction to Automated, Connected, and Intelligent Vehicles. Case studies: Automated, Connected, and Intelligent Vehicles

UNIT – II SENSOR TECHNOLOGY FOR SMART MOBILITY

UNIT – III CONNECTED AUTONOMOUS VEHICLE
Basic Control System Theory applied to Automobiles, Overview of the Operation of ECUs, Basic Cyber-Physical System Theory and Autonomous Vehicles, Role of Surroundings Sensing Systems and Autonomy, Role of Wireless Data Networks and Autonomy
UNIT – IV VEHICLE WIRELESS TECHNOLOGY & NETWORKING


UNIT – V CONNECTED CAR & AUTONOMOUS VEHICLE TECHNOLOGY


TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Recognize the concept of cyber-physical control systems and their application to collision avoidance and autonomous vehicles

CO2: Select the concept of remote sensing and the types of sensor technology needed to implement remote sensing

CO3: Familiar with the concept of fully autonomous vehicles

CO4: Apply the basic concepts of wireless communications and wireless data networks

CO 5: Analyze the concept of the connected vehicle and its role in automated vehicles

<table>
<thead>
<tr>
<th>COs/POs &amp; PSOs</th>
<th>POs</th>
<th>PSOs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO/PO &amp; PSO Average</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS

1. “Intelligent Transportation Systems and Connected and Automated Vehicles”, 2016, Transportation Research Board

REFERENCES

CME345  HAPTICS AND IMMERSIVE TECHNOLOGIES  

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

**COURSE OBJECTIVES**

1. To learn various immersive technologies of VR, AR and MR.
2. To learn software related to immersive technologies.
3. To learn the concepts of developing AR applications.
4. To learn the concepts of developing VR and unreal engine.
5. To study the haptic perception and extended reality.

**UNIT – I  INTRODUCTION TO IMMERSIVE TECHNOLOGIES**

Introduction on Virtual reality – Augmented reality – Mixed reality – Extended reality – VR Devices – AR Devices – Applications

**UNIT – II  SOFTWARE TOOLS**

Intro to Unity – Unity editor workspace – Intro to C# and visual studio - Programming in Unity – Intro to Unreal Engine – UE4 Editor workspace – Intro to Blueprint programming – Programming in Ue4

**UNIT – III  BUILDING AR APPLICATION WITH UNITY**

AR SDKs for unity and unreal engine – Working with SDKs for unity – Developing AR application in unity - Building AR application

**UNIT – IV  BUILDING VR APPLICATION WITH UNREAL ENGINE**

VR SDKs for unity and unreal engine – Developing VR application in Ue4 – Building VR application

**UNIT – V  HAPTIC PERCEPTION AND EXTENDED REALITY**

Extended Reality - Introduction to Haptics – Devices and possibilities – Custom Device development – Device Integration

TOTAL – 45 PERIODS

**OUTCOMES:** At the end of the course the students would be able to

1. Apply detailed knowledge about immersive technology
2. Gaining the knowledge of different types of Tools and Devices
3. Acquiring the knowledge about Unity and Unreal Engine
4. Explain the developing application in immersive technologies
5. Discuss about haptics in immersive technologies

**TEXT BOOKS:**

1. Immersive Multimodal Interactive Presence, by Angelika Peer (Editor), Christos D. Giachritsis (Editor), Springer; 2012th edition (13 April 2014), ISBN-10 : 1447162137

**REFERENCES:**

1. Practical Augmented Reality, by Steve Aukstakalnis, Addison-Wesley Professional; 1st edition (8 September 2016)
CRA332 DRONE TECHNOLOGIES

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

Low (1) ; Medium (2) ; High (3)

COURSE OBJECTIVES:
1. To understand the basics of drone concepts
2. To learn and understand the fundamentals of design, fabrication and programming of drone
3. To impart the knowledge of an flying and operation of drone
4. To know about the various applications of drone
5. To understand the safety risks and guidelines of fly safely

UNIT – I INTRODUCTION TO DRONE TECHNOLOGY
Drone Concept - Vocabulary Terminology- History of drone - Types of current generation of drones based on their method of propulsion- Drone technology impact on the businesses- Drone business through entrepreneurship- Opportunities/applications for entrepreneurship and employability

UNIT – II DRONE DESIGN, FABRICATION AND PROGRAMMING
Classifications of the UAV -Overview of the main drone parts- Technical characteristics of the parts -Function of the component parts -Assembling a drone- The energy sources- Level of autonomy- Drones configurations -The methods of programming drone- Download program - Install program on computer- Running Programs- Multi rotor stabilization- Flight modes -Wi-Fi connection.

UNIT – III DRONE FLYING AND OPERATION
Concept of operation for drone -Flight modes- Operate a small drone in a controlled environment- Drone controls Flight operations –management tool –Sensors-Onboard storage capacity -Removable storage devices- Linked mobile devices and applications

UNIT – IV DRONE COMMERCIAL APPLICATIONS
Choosing a drone based on the application -Drones in the insurance sector- Drones in delivering mail, parcels and other cargo- Drones in agriculture- Drones in inspection of transmission lines and power distribution -Drones in filming and panoramic picturing

UNIT – V FUTURE DRONES AND SAFETY
The safety risks- Guidelines to fly safely -Specific aviation regulation and standardization- Drone license- Miniaturization of drones- Increasing autonomy of drones -The use of drones in swarms

TOTAL: 45 PERIODS
COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Know about various types of drone technology, drone fabrication and programming.
CO2: Execute the suitable operating procedures for functioning a drone
CO3: Select appropriate sensors and actuators for Drones
CO4: Develop a drone mechanism for specific applications

CO-PO MAPPING:

<table>
<thead>
<tr>
<th>COs/POs&amp;PSOs</th>
<th>POs</th>
<th>PSOs</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO/PO &amp; PSO Average</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS

REFERENCES

COURSE OBJECTIVES
1. To study the value engineering process and able to identify its functions within the process.
2. To determine the appropriate value engineering methodology for a given project and propose appropriate training to centralized and decentralized modes.
3. To learn various decision-making processes and cost evaluation models and apply them in appropriately in the product development life-cycle.
4. To explore in-depth understanding of various value engineering applications in human resources, manufacturing and marketing.
5. To demonstrate to implement value engineering solutions and propose to perfect them.

UNIT – I VALUE ENGINEERING BASICS
Origin of value engineering - Meaning of value engineering - Definition of value engineering and Value analysis - Value Management - Value Analysis Versus Value Engineering - Value Analysis versus Traditional cost reduction techniques - Types of Value function – Basic and Secondary functions - concept of cost and worth - creativity in Value Engineering - uses, applications, advantages and
limitations of Value analysis.

UNIT – II VALUE ENGINEERING JOB PLAN AND PROCESS
Seven phases of job plan - FAST Diagramming as Value Engineering Tool - Behavioral and organizational aspects of Value Engineering - Ten principles of Value analysis - Benefits of Value Engineering.

UNIT – III VALUE ENGINEERING TECHNIQUES
Creativity - Brain storming - Gordon technique - Morphological Analysis - ABC Analysis - Probabilistic approach - Make or Buy decisions – Function cost worth analysis (FCWA) - Function Analysis System technique (FAST) - Break Even Analysis - Life cycle cost (LCC)

UNIT – IV WORKSHEETS AND GUIDELINES

UNIT – V VERSATILITY OF VALUE ENGINEERING
Value engineering operation in maintenance and repair activities - value engineering in non hardware projects - Initiating a value engineering programme Introduction - training plan - career development for value engineering specialties.

OUTCOMES: At the end of the course the students would be able to
1. Estimate a product cost based on value engineering principles in terms of its values, functions and worthiness.
2. Discuss the product and articulate it in various phases of value engineering
3. Discuss and select appropriate methods, standards and apply them on value engineering project and propose appropriate training
4. Apply querying theory and FAST to perfect a value engineering project implementation.
5. Develop various case studies related to value engineering project implementation.

TOTAL :45 PERIODS

TEXT BOOKS:

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>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
CME339 ADDITIVE MANUFACTURING  
\[ L \ T \ P \ C \]
\[ 2 \ 0 \ 2 \ 3 \]

COURSE OBJECTIVES:

- To introduce the development of Additive Manufacturing (AM), various business opportunities and applications.
- To familiarize various software tools, processes and techniques to create physical objects that satisfy product development / prototyping requirements, using AM.
- To be acquainted with vat polymerization and direct energy deposition processes.
- To be familiar with powder bed fusion and material extrusion processes.
- To gain knowledge on applications of binder jetting, material jetting and sheet lamination processes.

UNIT I INTRODUCTION 6

UNIT II DESIGN FOR ADDITIVE MANUFACTURING (DfAM) 6

UNIT III VAT POLYMERIZATION AND DIRECTED ENERGY DEPOSITION 6

UNIT IV POWDER BED FUSION AND MATERIAL EXTRUSION 6

UNIT V OTHER ADDITIVE MANUFACTURING PROCESSES 6

**ADDITIVE MANUFACTURING LABORATORY**

**Experiments**
1. Modelling and converting CAD models into STL file.
3. Design and fabrication of parts by varying part orientation and support structures.
4. Fabrication of parts with material extrusion AM process.
5. Fabrication of parts with vat polymerization AM process.
6. Design and fabrication of topology optimized parts.

**TOTAL: 30 PERIODS**

**Equipment required - lab**
1. Extrusion based AM machine
2. Resin based AM machine
3. Mechanical design software
4. Open-source AM software for STL editing, manipulation and slicing.

**TOTAL: 30 PERIODS**

**COURSE OUTCOMES:**
At the end of this course students shall be able to:
CO1: Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.
CO2: Acquire knowledge on process of transforming a concept into the final product in AM technology.
CO3: Elaborate the vat polymerization and direct energy deposition processes and its applications.
CO4: Acquire knowledge on process and applications of powder bed fusion and material extrusion.
CO5: Evaluate the advantages, limitations, applications of binder jetting, material jetting and sheet lamination processes.

**TEXT BOOKS:**

**REFERENCES:**

**CME340 CAD/CAM**

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

**COURSE OBJECTIVES**
1. To Introduce and understand the Basic of Design.
2. To study the two dimensional drafting and bill of material creation.
3. To learn three dimensional modeling and its advantages.
4. To study the basic and purpose of assembling modeling.
5. To study the basics of computer aided machining and part programming.

UNIT – I  BASICS OF DESIGNS  
Understanding of Projections, Scales, units, GD & T; its 14 symbols, Special characteristics & Title Block readings. Revision / ECN status of drawings – Customer Specific requirements – Drawing Grid reading

UNIT – II  2D DRAFTING  
Projection views – Orthographic view, Axillary view, Full & Half Section views, Broken Section view, Offset Section view – Title Block creation – BOM Creation – Notes creation – Ballooning of 2D drawing and its features for Inspection reporting

UNIT – III  3D MODELING  

UNIT – IV  ASSEMBLY MODELING  
Basics of Assembly modeling, Purpose of Assembly modeling & amp; its advantages – Top to Down & BottomUp modeling approaches – Analysis of Clearances – Undercuts – Interferences – Stack up analysis – Cumulative effect of Tolerances in after assembly conditions.

UNIT – V  CAM  

TOTAL : 45 PERIODS

OUTCOMES: At the end of the course the students would be able to
1. Discuss the basics of the design and concepts.
2. Develop the two dimensional drafting and projection views.
3. Discuss the three dimensional modeling, parametric and Non-parametric modeling
4. Discuss the assembly modeling and top down, bottom up approaches.
5. Develop the computer aided machining and wirting part programming.

TEXT BOOKS:
1. Computer Aided Design &amp; Manufacturing - Jacob Moses &amp; Ruchi Agarwal
2. CAD / CAM Principles &amp; Application - J. Srinivas

REFERENCES:
1. CAD / CAM - Ibrahim Zaid (Text &amp; Reference Book)
2. CAD / CAM – Chandandeep Grewal
3. CAD CAM &amp; Automation - FarazdKHaideri (Text &amp; Reference Book)
4. Computer Aided Design &amp; Manufacturing – Anup Goel
5. CAD / CAM – PN Rao

<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>
CME341  DESIGN FOR X  L  T  P  C  3  0  0  3

COURSE OBJECTIVES
1. To introduce the economic process selection principles and general design principles for manufacturability in the development and design of products for various engineering applications. Also, apply design consideration principles of casting in the design of cast products.
2. To learn the design consideration principles of forming in the design of extruded, stamped, and forged products.
3. To learn design consideration principles of machining in the design of turned, drilled, milled, planed, shaped, slotted, and ground products.
4. To learn design consideration principles of welding in the design of welded products.
5. To learn design consideration principles in additive manufacturing.

UNIT – I  INTRODUCTION
9
General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances GeometricTolerances - Assembly limits - Datum features - Tolerance stacks.

UNIT – II  FACTORS INFLUENCING FORM DESIGN
9
Working principle, Material, Manufacture, Design - Possible solutions - Materials choice – Influence of materials on form design - form design of welded members, forgings and castings.

UNIT – III  COMPONENT DESIGN - MACHINING CONSIDERATION
9

UNIT – IV  COMPONENT DESIGN – CASTING CONSIDERATION
9
Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA.

UNIT – V  DESIGN FOR ADDITIVE MANUFACTURING
9

Low (1) ; Medium (2) ; High (3)
Introduction to AM, DFMA concepts and objectives, AM unique capabilities, exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/numbers.

**OUTCOMES:** At the end of the course the students would be able to
1. Elaborate the design principles for manufacturability
2. Discuss the factors influencing in form design
3. Apply the component design features of various machine.
4. Discuss the design consideration principles of welding in the design of welded products.
5. Discuss the design consideration principles of additive manufacturing.

**TEXT BOOKS:**

**REFERENCES:**

<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>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Low (1); Medium (2); High (3)

CME342 ERGONOMICS IN DESIGN

<table>
<thead>
<tr>
<th>COURSE OBJECTIVES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 To introduce to industrial design based on ergonomics.</td>
</tr>
<tr>
<td>2 To consider ergonomics concept in manufacturing</td>
</tr>
<tr>
<td>3 To apply ergonomics in design of controls and display.</td>
</tr>
<tr>
<td>4 To apply environmental factors in ergonomics design.</td>
</tr>
<tr>
<td>5 To develop aesthetics applicable to manufacturing and product</td>
</tr>
</tbody>
</table>

UNIT – I INTRODUCTION
An approach to industrial design, Elements of design structure for industrial design in engineering application in modern manufacturing systems- Ergonomics and Industrial Design: Introduction to Ergonomics, Communication system, general approach to the man-machine relationship, Human component of work system, Machine component of work system, Local environment-light, Heat, Sound.
UNIT – II  ERGONOMICS AND PRODUCTION  
Introduction, Anthropometric data and its applications in ergonomic, working postures, Body Movements, Work Station Design, Chair Design. Visual Effects of Line and Form: The mechanics of seeing, Psychology of seeing, Figure on ground effect, Gestalt’s perceptions - Simplicity, Regularity, Proximity, Wholeness. Optical illusions, Influences of line and form.

UNIT – III  DESIGN PRINCIPLES FOR DISPLAY AND CONTROLS  
Displays: Design Principles of visual Displays, Classification, Quantitative displays, Qualitative displays, check readings, Situational awareness, Representative displays, Design of pointers, Signal and warning lights, colour coding of displays, Design of multiple displays Controls: Design considerations, Controls with little efforts – Push button, Switches, rotating Knobs. Controls with muscular effort – Hand wheel, Crank, Heavy lever, Pedals. Design of controls in automobiles, Machine Tools.

UNIT – IV  ENVIRONMENTAL FACTORS  
Colour: Colour and light, Colour and objects, Colour and the eye – after Image, Colour blindness, Colour constancy, Colour terms – Colour circles, Munsel colour notation, reactions to colour and colour combination – colour on engineering equipments, Colour coding, Psychological effects, colour and machine form, colour and style.

UNIT – V  AESTHETIC CONCEPTS  
Concept of unity, Concept of order with variety, Concept of purpose, Style and environment, Aesthetic expressions - Symmetry, Balance, Contrast, Continuity, Proportion. Style - The components of style, House style, Style in capital good. Introduction to Ergonomic and plant layout software’s, total layout design.

OUTCOMES: At the end of the course the students would be able to
1. Appreciate ergonomics need in the industrial design.
2. Apply ergonomics in creation of manufacturing system
3. Discuss on design of controls and display.
4. Consider environmental factors in ergonomics design.
5. Report on importance of aesthetics to manufacturing system and product

TOTAL: 45 PERIODS

TEXT BOOKS:
1. Ergonomics in Design: Methods and Techniques (Human Factors and Ergonomics) by Marcelo M. Soares, Francisco Rebelo
2. Ergonomics in Product Design by Sendpoints Publishing Co. Ltd.

REFERENCES:
COURSE OBJECTIVES

1. To introduce the fundamental concepts of the new product development
2. To develop material specifications, analysis and process.
3. To Learn the Feasibility Studies & reporting of new product development.
4. To study the New product qualification and Market Survey on similar products of new product development
5. To learn Reverse Engineering. Cloud points generation, converting cloud data to 3D model

UNIT – I  FUNDAMENTALS OF NPD

UNIT – II  MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS
Material specification standards – ISO, DIN, JIS, ASTM, EN, etc. – Awareness on various manufacturing process like Metal castings & Forming, Machining (Conventional, 3 Axis, 4 Axis, 5 Axis, ), Fabrications, Welding process. Qualifications of parts mechanical, physical & Chemical properties and their test report preparation and submission. Fundamentals of DFMEA & PFMEA, Fundamentals of FEA, Bend Analysis, Hot Distortion, Metal and Material Flow, Fill and Solidification analysis.

UNIT – III  ESSENTIALS OF NPD

UNIT – IV  CRITERIONS OF NPD
New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for testing frequencies. Market Survey on similar products, Risk analysis, validating samples with simulation results, Lesson Learned & Horizontal deployment in NPD.

UNIT – V  REPORTING & FORWARD-THINKING OF NPD
Detailed study on PPAP with 18 elements reporting, APQP and its 5 Sections, APQP vs PPAP, Importance of SOP (Standard Operating Procedure) – Purpose & documents, deployment in shop floor. Prototyping & RPT - Concepts, Application and its advantages, 3D Printing – resin models, Sand cores for foundries; Reverse Engineering. Cloud points generation, converting cloud data to 3D model – Advantages & Limitation of RE, CE (Concurrent Engineering) – Basics, Application and its advantages in NPD (to reduce development lead time, time to Market, Improve productivity and product cost.)

OUTCOMES: At the end of the course the students would be able to
1. Discuss fundamental concepts and customer specific requirements of the New Product development
2. Discuss the Material specification standards, analysis and fabrication, manufacturing process.
3. Develop Feasibility Studies & reporting of New Product development
4. Analyzing the New product qualification and Market Survey on similar products of new product development
5. Develop Reverse Engineering. Cloud points generation, converting cloud data to 3D model

TEXT BOOKS:
CME344  PRODUCT LIFE CYCLE MANAGEMENT  

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

Low (1) ;       Medium (2) ;       High (3)

COURSE OBJECTIVES
1  To study about the history, concepts and terminology in PLM
2  To learn the functions and features of PLM/PDM
3  To develop 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, Coax& 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.-Architecture of PLM software- selection criterion of software for particular application - Brand name to be removed
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- process compliance and process automation

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

TOTAL: 45 PERIODS

OUTCOMES: At the end of the course the students would be able to
1. Summarize the history, concepts and terminology of PLM
2. Develop the functions and features of PLM/PDM
3. Discuss different modules offered in commercial PLM/PDM tools.
4. Interpret the implement PLM/PDM approaches for industrial applications.
5. Integrate PLM/PDM with legacy data bases, CAx& ERP systems

TEXT BOOKS:

REFERENCES:

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

Low (1) ; Medium (2) ; High (3)
CME346  DIGITAL MANUFACTURING AND IoT  L  T  P  C
2  0  2  3

COURSE OBJECTIVES
1. To study the various aspects of digital manufacturing.
2. To inculcate the importance of DM in Product Lifecycle Management and Supply chain Management.
3. To formulate of smart manufacturing systems in the digital work environment.
4. To interpret IoT to support the digital manufacturing.
5. To elaborate the significance of digital twin.

UNIT – I  INTRODUCTION 6

UNIT – II  DIGITAL LIFE CYCLE & SUPPLY CHAIN MANAGEMENT 6

UNIT – III  SMART FACTORY 6
Smart Factory – Levels of Smart Factories – Benefits – Technologies used in Smart Factory – Smart Factory in IoT - Key Principles of a Smart Factory – Creating a Smart Factory – Smart Factories and Cybersecurity

UNIT – IV  INDUSTRY 4.0 6

UNIT – V  STUDY OF DIGITAL TWIN 6

TOTAL :30 PERIODS

DIGITAL MANUFACTURING AND IoT LABORATORY
Experiments
1. Measure the Distance Using Ultrasonic Sensor and Make Led Blink Using Arduino
2. Detect the Vibration of an Object Using Arduino
3. Sense a Finger When it is Placed on Board Using Arduino
4. Temperature Notification Using Arduino
5. Switch Light On and Off Based on the Input of User Using Raspberry Pi
6. Connect with the Available Wi-Fi Using Arduino

TOTAL : 30 PERIODS

OUTCOMES: At the end of the course the students would be able to
1. Impart knowledge to use various elements in the digital manufacturing.
2. Differentiate the concepts involved in digital product development life cycle process and supply chain management in digital environment.
3. Select the proper procedure of validating practical work through digital validation in Factories.
4. Implementation the concepts of IoT and its role in digital manufacturing.
5. Analyse and optimize various practical manufacturing process through digital twin.
TEXT BOOKS:

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>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Low (1) ;     Medium (2) ;       High (3)

CME347          LEAN MANUFACTURING          L T P C
3 0 0 3

COURSE OBJECTIVES
1. To introduce the basics of 6 SIGMA
2. To learning about the lean manufacturing tools.
3. To study about the deeper understanding methodologies of Lean manufacturing.
4. To study the lean concepts and its elements.
5. To learn implementation and challenges of lean manufacturing.

UNIT – I   BASICS OF 6 SIGMA
9
Introduction to 6 Sigma, basic tools of six sigma like problem solving approach, standard deviation, normal distribution, various sigma levels with some examples, value for the enterprise, Variation, and sources of variation, Mean and moving the mean, Various quality costs, cost of poor quality.

UNIT – II   INTRODUCTION TO LEAN MANUFACTURING TOOLS
9

UNIT – III   DEEPER UNDERSTANDING METHODOLOGIES
9
What is a process, Why Process management, Keys to process management, Difference between process management and 6 Sigma, Introduction to Deming cycle, PDCA, DMAIC and continuous improvement, DMEDI for creation process, DMAIC Vs DMEDI with examples, Introduction to Toyota Production System, Six Sigma and Production System integration.
UNIT – IV       LEAN ELEMENTS
Introduction to Lean Concepts like In-Built Quality, Concept of Right Part at the Right Time, Lead Time reduction, Optimum utilization of Capital, Optimum utilization of People. Understanding the Zero-defect concept and Metrics, Focus on Human Resources, Quality, Delivery, Cost. Building Zero defect capabilities, Cultural and Organizational aspects

UNIT – V       IMPLEMENTATION AND CHALLENGES
Implementing Checks and Balances in the process, Robust Information Systems, Dashboard, follow up and robust corrective and preventive mechanism. Concept of Audits, and continuous improvement from gap analysis, risk assessments etc.

TOTAL : 45 PERIODS

OUTCOMES: At the end of the course the students would be able to
1. Discuss the basics of 6 SIGMA
2. Elaborate the lean manufacturing tools.
3. Illustrate about the deeper understanding methodologies of Lean manufacturing.
4. Discuss lean concepts and its elements.
5. Describe the implementation and challenges of lean manufacturing.

TEXT BOOKS:
2. Lean Manufacturing: Principles to Practice by Akhilesh N. Singh, Bibliophile SouthAsia
3. The Toyota Way: 14 Management Principles

REFERENCES:
2. International Society of Six Sigma Professionals: https://isssp.org/about-us/
4. Older / Previous editions of AIAG manuals on APQP, FMEA and PPAP. These are great sources of information on Quality Planning and has basics of Project Management and required skills.
5. Quality Management for Organizations Using Lean Six Sigma Techniques- Erick C Jones

<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>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Low (1) ; Medium (2) ; High (3)

161
CME348 MODERN ROBOTICS

L T P C
2 0 2 3

COURSE OBJECTIVES
1. To introduce definition, history of robotics and robot anatomy.
2. To learn the simulation of robot kinematics.
3. To study the grasping and manipulation of robots.
4. To study about mobile robot and manipulation.
5. To study the applications of industrial, service, domestic robots.

UNIT – I INTRODUCTION
6
Robot: Definition, History of Robotics, Robot Anatomy, Co-ordinate systems, types and classification, Configuration space and degrees of freedom of rigid bodies and robots, Configuration space topology and representation; configuration and velocity constraints; task space and workspace, Rigid-body motions, rotation matrices, angular velocities, and exponential coordinates of rotation, Homogeneous transformation matrices.

UNIT – II SIMULATION OF ROBOT KINEMATICS
6
Robot kinematics, Forward and inverse kinematics (two three four degrees of freedom), Forward and inverse kinematics of velocity, Homogeneous transformation matrices, translation and rotation matrices Dennavit and Hartenberg (D-H) transformation, Dynamics of Open Chains, Trajectory Generation, motion planning, robot control: First- and second-order linear error dynamics, stability of a feedback control system.

UNIT – III GRASPING AND MANIPULATION OF ROBOTS
6
Kinematics of contact, contact types (rolling, sliding, and breaking), graphical methods for representing kinematic constraints in the plane, and form-closure grasping, Coulomb friction, friction cones, graphical methods for representing forces and torques in the plane, End effectors, grippers, types of gripper, gripper force analysis, and examples of manipulation and grasping.

UNIT – IV MOBILE ROBOTS
6
Mobile robot, Wheeled Mobile Robots: Kinematic models of omnidirectional and non-holonomic wheeled mobile robots, Controllability, motion planning, feedback control of non-holonomic wheeled mobile robots; odometry for wheeled mobile robots; and mobile manipulation. Reference Trajectory generation, feed forward control

UNIT – V APPLICATIONS OF ROBOTS
6
Application of robotic: industrial robots, Service robots, domestic and house hold robots, Medical robots, military robots, agricultural robots, space robots, Aerial robotics Role of robots in inspection, assembly, material handling, underwater, space and healthcare

TOTAL :30 PERIODS

MODERN ROBOTICS LABORATORY
Experiments
1. 3D modeling and motion simulation of rotational joint assembly
2. 3D modeling and motion simulation of prismatic joint assembly
3. 3D modeling and motion simulation of Cartesian robot
4. 3D modeling and motion simulation of articulated robot
5. 3D modeling and motion simulation of spherical robot
6. 3D modeling and motion simulation of cylindrical robot

TOTAL :30 PERIODS

OUTCOMES: At the end of the course the students would be able to
1. Discuss the definition, history of robotics and robot anatomy.
2. Develop the simulation of robot kinematics
3. Describe the grasping and manipulation of robots.
4. Explain about mobile robot and manipulation.

162
5. Discuss the applications of industrial, service, domestic robots.

TEXT BOOKS:

REFERENCES:
5. Modern Robotics Hardcover by Lauren Barrett (Editor), Murphy & Moore Publishing (1 March 2022), ISBN-10: 1639873732

<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>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CME349 GREEN MANUFACTURING DESIGN AND PRACTICES L T P C 3 0 0 3

COURSE OBJECTIVES
1. To introduce the concept of environmental design and industrial ecology.
2. To impart knowledge about air pollution and its effects on the environment.
3. To enlighten the students with knowledge about noise and its effects on the environment.
4. To enlighten the students with knowledge about water pollution and its effects on the environment.
5. To introduce the concept of green co-rating and its need

UNIT – I DESIGN FOR ENVIRONMENT AND LIFE CYCLE ASSESSMENT 9

UNIT – II AIR POLLUTION SAMPLING AND MEASUREMENT 9
Primary and Secondary Pollutants, Automobile Pollutants, Industrial Pollution, Ambient air quality Standards, Metrological aspects of air Pollution, Temperature lapse Rates and Stability-wind velocity and turbulence-Pump behavior dispersion of air Pollutants-solution to the atmosphere dispersion
equation—the Gaussian Plume Model, Air pollution sampling-collection of gaseous air pollutants-collection of particulate pollutants-stock sampling, analysis of air pollutants-sulfur dioxide-nitrogen dioxide, carbon monoxide, oxidants and ozone.

UNIT – III NOISE POLLUTION AND CONTROL
9
Frequency and Sound Levels, Units of Noise based power radio, contours of Loudness. Effect of human, Environment and properties, Natural and Anthrogenic Noise Sources, Measuring Instruments for frequency and Noise levels, Masking of sound, Types, Kinetics, Selection of different reactors used for waste treatment, Treatment of noise at source, Path and Reception, Sources of noise, Effects of noise-Occupational Health hazards, thermal Comforts, Heat Island Effects, Radiation Effects.

UNIT – IV WATER DEMAND AND WATER QUALITY
9
Factors affecting consumption, Variation, Contaminants in water, Nitrates, Fluorides, Detergents, taste and odour, Radio activity in water, Criteria, for different impurities in water for portable and non-portable use, Point and non-point Source of pollution, Major pollutants of Water, Water Quality Requirement for different uses, Global water crisis issues.

UNIT – V GREEN CO-RATING
9

OUTCOMES: At the end of the course the students would be able to
1. Explain the environmental design and selection of eco-friendly materials.
2. Analyse manufacturing processes towards minimization or prevention of air pollution.
3. Analyse manufacturing processes towards minimization or prevention of noise pollution.
4. Analyse manufacturing processes towards minimization or prevention of water pollution.
5. Evaluate green co-rating and its benefits.

TEXT BOOKS:

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>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td>3</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td>3</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td>3</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td>3</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td>3</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Low (1) ; Medium (2) ; High (3)
CME350  ENVIRONMENT SUSTAINABILITY AND IMPACT ASSESSMENT  L  T  P  C
                                           3  0  0  3

COURSE OBJECTIVES
1. To make the students to understand the concepts of Environmental Sustainability & Impact Assessment
2. To familiarize the students in environmental decision making procedure.
3. Make the students to identify, predict and evaluate the economic, environmental, and social impact of development activities
4. To provide information on the environmental consequences for decision making
5. To promote environmentally sound and sustainable development through the identification of appropriate alternatives and mitigation measures.

UNIT – I  ENVIRONMENTAL IMPACT ASSESSMENT  9
Environmental impact assessment objectives – rationale and historical development of EIA - Conceptual frameworks for EIA Legislative development – European community directive – Hungarian directive.

UNIT – II  ENVIRONMENTAL DECISION MAKING  9
Strategic environmental assessment and sustainability appraisal – Mitigation, monitoring and management of environmental impacts- Socio economic impact assessment.

UNIT – III  ENVIRONMENTAL POLICY, PLANNING AND LEGISLATION  9
Regional spatial planning and policy – Cumulative effects assessment – Planning for climate change, uncertainty and risk.

UNIT – IV  LIFE CYCLE ASSESSMENT  9
Life cycle assessment; Triple bottom line approach; Industrial Ecology. Ecological foot printing, Design for Environment, Future role of LCA, Product stewardship, design, durability and justifiability, measurement techniques and reporting.

UNIT – V  SUSTAINABLE URBAN ECONOMIC DEVELOPMENT  9
Spatial economics – Knowledge economy and urban regions.

TOTAL: 45 PERIODS

OUTCOMES: At the end of the course the students would be able to:
1. Explain the concepts of Environment Sustainability and trained to make decision related to Environment.
2. Make decision that has an effect on our environment
3. Evaluate the basics of environmental policy, planning and various legislation
   Get valuable information for exploring decisions in each life stage of materials, buildings, services and infrastructure.
4. Explain the Life cycle assessment of Environmental sustainability.
5. Explain sustainable urban economic development.

TEXT BOOKS:
REFERENCES:
2. Robert B Gibsan, Sustainability Assessment, Earth Scan publishers, 2005

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

Low (1) ; Medium (2) ; High (3)

CME351 ENERGY SAVING MACHINERY AND COMPONENTS

COURSE OBJECTIVES
1. To introduce the various energy saving machineries and components to the students for the purpose of conserving energy.
2. To study the basics and principles of transforms, Pumps and motors.
3. To impart the knowledge about the methods of energy conservation.
4. To introduce the energy efficiency devices and concepts of ENCON.
5. To impart the knowledge about CO2 mitigation.

UNIT – I BASICS OF ELECTRICAL ENERGY USAGE

UNIT – II TRANSFORMERS AND MOTORS

UNIT – III FANS, PUMPS AND COMPRESSORS
UNIT – IV STUDY OF ILLUMINATION AND ENERGY EFFICIENT DEVICES

UNIT – V CO2 MITIGATION AND CASE STUDIES

OUTCOMES: At the end of the course the students would be able to

1. Explain the various energy saving machinery and components.
2. Evaluate the various methods of conservation of energy.
3. Evaluate the performance and energy conservation of fans, pumps and compressors.
4. Discuss the various energy efficiency devices.
5. Explain the co2 mitigation and cost factor.

TEXT BOOKS:

REFERENCES:

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

Low (1) ; Medium (2) ; High (3)
CME352 GREEN SUPPLY CHAIN MANAGEMENT  L  T  P  C
3  0  0  3

COURSE OBJECTIVES
1. To familiar the various standards and legislation of modern electronic manufacturing.
2. To know the conventional electronic processing and lead-free electronic manufacturing techniques.
3. To recognize the steps involved in assembly process and understand the need of recycle the electronics.
5. To demonstrate the green electronic manufacturing procedure in applications.

UNIT – I INTRODUCTION TO GREEN ELECTRONICS
Environmental concerns of the modern society - Overview of electronics industry and their relevant regulations in China, European Union and other key countries - global and regional strategy and policy on green electronics industry. Restriction of Hazardous substances (RoHS) - Waste Electrical and electronic equipment (WEEE) - Energy using Product (EuP) and Registration - Evaluation, Authorization and Restriction of Chemical substances (REACH).

UNIT – II GREEN ELECTRONICS MATERIALS AND PRODUCTS

UNIT – III GREEN ELECTRONICS ASSEMBLY AND RECYCLING
Various processes in assembling electronics components – the life-cycle environmental impacts of the materials used in the processes - substrate interconnects. Components and process equipments - Technology and management on e-waste recycle system construction, global collaboration, and product disassembles technology.

UNIT – IV PRODUCT DESIGN AND SUSTAINABLE ECO-DESIGN
Stages of product development process in green design: Materials- Manufacturing - Packaging and use - End of Life and disposal - Design for recycling - Life Cycle Assessment (LCA), and Eco-design tools - Environmental management systems, and International standards - Eco-design in electronics industry.

UNIT – V CASE STUDIES

TOTAL:45 PERIODS

OUTCOMES: At the end of the course the students would be able to
2. Explain the conventional electronic processing and lead free electronic manufacturing techniques.
3. Realize the assembly process and the need of recycle of electronics.
5. Validate the green electronic manufacturing procedures in applications.
TEXT BOOKS:

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>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td>3</td>
<td>1</td>
<td></td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td>3</td>
<td>1</td>
<td></td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td>3</td>
<td>1</td>
<td></td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td>3</td>
<td>1</td>
<td></td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td>3</td>
<td>1</td>
<td></td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

Low (1) ; Medium (2) ; High (3)

CIM331 SERVICES OPERATIONS MANAGEMENT

COURSE OBJECTIVES
The objective of the course is
- To understand the growing significance
- To impact of services on the growth and economy
- To apply the knowledge of service process management
- To apply and improving service delivery propositions
- To understand the knowledge of AI

UNIT I UNDERSTANDING SERVICE OPERATIONS
Introduction; Nature & Role of Services in Economy; Service Operations and their Management Fundamentals; Service Strategy; Positioning of Services in the Organisation Value Chain Module

UNIT II SERVICE OPERATION INFRASTRUCTURE
Service Facility Design, Layout & Location, Off-shoring & Outsourcing; Technology in Services, Front-office Back-office Interface; Human Factor in Services; External Associates in Service Processes
UNIT III  SERVICE PROCESS MANAGEMENT  9
Service Encounter Design and Control; Managing Service Processes; Experience
Management in Service Operations; Service Quality and Reliability Assurance; Service
Process Improvement & the Associated Methodologies; Experience Innovation Paradigm;
New Service Development

UNIT IV  IMPROVING SERVICE DELIVERY PROPOSITIONS  9
Service Growth and Globalization; Forecasting Demand for Services; Capacity and Demand
Management; Customer Expectations and the Planned Provision in Service Delivery; Legal
Aspects of Expectation-Delivery Gaps; Service Waiting Line and Customer Relationship
Management; Inventory Management for Improved service Delivery Module

UNIT V  INCORPORATING AI AND OTHER LATEST TECHNOLOGIES
IN SERVICE OPERATIONS  9
Introduction to AI and other new age technologies. AI as a service (AlaaS). Futuristic
Scenario of incorporating new technologies like cloud computing, simulation, robotics etc in
service operations

TOTAL: 45 PERIODS

COURSE OUTCOMES
• CO1: Understanding the growing significance
• CO2: Impacting of services on the growth and economy
• CO3: Applying the knowledge of service process management
• CO4: Analysing and improving service delivery propositions
• CO5: Understanding the knowledge of AI

TEXT BOOKS
1. Deborah (2008), Competitive Strategies for Service Businesses, New Delhi: Jaico
5. Johnston & Clark (2009), Service Operations Management, Pearson Education
7. Davis & Heineke (2003), Managing Services: People and Technology, Tata McGraw Hill

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3</td>
<td>1 2 3</td>
</tr>
<tr>
<td>1</td>
<td>3 2</td>
<td>1 2 2</td>
</tr>
<tr>
<td>2</td>
<td>2 3</td>
<td>2 3 2</td>
</tr>
<tr>
<td>3</td>
<td>3 2</td>
<td>3 3 2</td>
</tr>
<tr>
<td>4</td>
<td>3 2</td>
<td>2 3 3</td>
</tr>
<tr>
<td>5</td>
<td>3 2</td>
<td>2 3 3</td>
</tr>
<tr>
<td>Avg.</td>
<td>2.6</td>
<td>2.6 2.25</td>
</tr>
</tbody>
</table>
CIE360 DESIGN THINKING AND INNOVATION

COURSE OBJECTIVES:
- To understand the basic concepts of process of design
- To explain the concept of design thinking for product and service development
- To explain the fundamental concept of innovation and design thinking
- To discuss the methods of implementing design thinking in the real world.
- To apply the concepts of design thinking workshop

UNIT I PROCESS OF DESIGN

UNIT II TOOLS FOR DESIGN THINKING
Real-Time design interaction capture and analysis – Enabling efficient collaboration in digital space – Empathy for design – Collaboration in distributed Design

UNIT III DESIGN THINKING IN IT
Design Thinking to Business Process modelling – Agile in Virtual collaboration environment – Scenariobased Prototyping

UNIT IV DT FOR STRATEGIC INNOVATIONS

UNIT V DESIGN THINKING WORKSHOP
Design Thinking Work shop Empathize, Design, Ideate, Prototype and Test

TOTAL = 45 PERIODS

COURSE OBJECTIVES
CO1 Appreciate various design process procedure
CO2 Generate and develop design ideas through different technique
CO3 Identify the significance of reverse Engineering to Understand Products
CO4 Draw technical drawing for design ideas
CO5 Apply the concepts of design thinking workshop

CO’s- PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</th>
<th>PSO’s</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>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>AVG.</td>
<td>2.6</td>
<td>2.4</td>
</tr>
</tbody>
</table>
TEXT BOOKS:

REFERENCES:

CAU331 INTELLECTUAL PROPERTY RIGHTS L T P C
3 0 0 3

COURSE OBJECTIVES:
- To understand the basic concepts of IPR
- To learn the basic concepts of Registrations of IPRs
- To study the concepts of Agreements and Legislations
- To apply the knowledge of digital products and law
- To apply the concepts of enforcement of IPRs

UNIT I INTRODUCTION
Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO – TRIPS; Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II REGISTRATION OF IPRs
Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad.

UNIT III AGREEMENTS AND LEGISLATIONS

UNIT IV DIGITAL PRODUCTS AND LAW

UNIT V ENFORCEMENT OF IPRs
Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
CO1: Understanding the basic concepts of IPR
CO2: Learning the basic concepts of Registrations of IPRs
CO3: Studying the concepts of Agreements And Legislations
CO4: Applying the knowledge of digital products and law
CO5: Applying the concepts of enforcement of IPRs

TEXT BOOKS

REFERENCES

CO PO Mapping

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Avg.</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:

- To understand the basic concepts of technology management
- To learn the knowledge of technology forecasting
- To analyse the evaluation of technology
- To apply the concepts of technology transfer and acquisition
- To understand the concepts of technology absorption and innovation

UNIT I TECHNOLOGY MANAGEMENT 9
Scope, components, and overview. Technology and environment, Technology and society, Technology Impact analysis, environmental, social, legal, political aspects, techniques for analysis - steps involved. Technology policy strategy: Science and technology Policy of India, implications to industry

UNIT II TECHNOLOGY FORECASTING 9

UNIT III TECHNOLOGY CHOICE AND EVALUATION 9
Methods of analysing alternate technologies, Techno-economic feasibility studies, Need for multi-criteria considerations such as, social, environmental, and political, Analytic hierarchy method, Fuzzy multi-criteria decision making, and other methods.

UNIT IV TECHNOLOGY TRANSFER AND ACQUISITION 9
Import regulations, Implications of agreements like Uruguay Round and WTO, Bargaining process, Transfer option, MOU - Technology Adoption and Productivity, Adopting technology-human interactions, Organisational redesign and re-engineering, Technology productivity.

UNIT V TECHNOLOGY ABSORPTION AND INNOVATION 9

TOTAL : 45 PERIODS

COURSE OUTCOMES:

- CO1: Understanding the basic concepts of technology management
- CO2: Learning the knowledge of technology forecasting
- CO3: Analysing the evaluation of technology
- CO4: Applying the concepts of technology transfer and acquisition
- CO5: Understanding the concepts of technology absorption and innovation

TEXT BOOKS:

REFERENCES:
CIM333

STRATEGIC MANAGEMENT

COURSE OBJECTIVES:
- To understand the basic concept of strategy and process
- To learn the knowledge about competitive advantage
- To apply the concepts of strategies in business level
- To implementation the concepts of strategies
- To understand the concepts of other strategic issues

UNIT I

STRATEGY AND PROCESS


UNIT II

COMPETITIVE ADVANTAGE


UNIT III

STRATEGIES


UNIT IV

STRATEGY IMPLEMENTATION & EVALUATION

The implementation process, Resource allocation, Designing organizational structure-Designing Strategic Control Systems- Matching structure and control to strategy-Implementing Strategic change-Politics-Power and Conflict- Techniques of strategic evaluation and control – case study.
UNIT V OTHER STRATEGIC ISSUES
Managing Technology and Innovation - Strategic issues for Non Profit organisations. New Business Models and strategies for Internet Economy - case study

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Understanding the basic concept of strategy and process
CO2: Learning the knowledge about competitive advantage
CO3: Applying the concepts of strategies in business level
CO4: Implementing the concepts of strategies
CO5: Understanding the concepts of other strategic issues

REFERENCES:

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>AVG.</td>
<td>2.2</td>
<td>2.3</td>
</tr>
</tbody>
</table>

CIE364 SAFETY ENGINEERING AND MANAGEMENT

COURSE OBJECTIVES:
- Identify unsafe conditions and recognize unsafe alerts.
- Interpret the rules and regulations for safety operations.
- Capable of solving problems of accidents.
- Capable of solving the present for criticizing the present for improved safety.
- Collaborate and modify processes/policies for safety

UNIT I INTRODUCTION
Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.

UNIT II CHEMICAL HAZARDS
Chemical exposure – Toxic materials – Radiation Ionizing and Non-ionizing Radiation – Industrial
Hygiene – Industrial Toxicology.

UNIT III  ENVIRONMENTAL CONTROL
Industrial Health Hazards – Environmental Control–IndustrialNoise-Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.

UNIT IV  HAZARDANALYSIS
System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment.

UNIT V  SAFETY REGULATIONS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students will be able to
CO1: Identify and prevent chemical, environmental mechanical, fire hazard.
CO2: Collect, analyze and interpret the accidents data based on various safety techniques.
CO3: Apply proper safety techniques on safety engineering and management.
CO4: Able to perform hazard analysis.
CO5 : Aid to design the system with environmental consciousness by implementing safety regulation.

CO’s- PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>AVg.</td>
<td>2.6</td>
<td>2.6</td>
</tr>
</tbody>
</table>

TEXT BOOK:

REFERENCES:

COURSE OBJECTIVES:
- To understand the basic concepts of human rights
• To learn knowledge about the evaluation of human rights
• To study the concepts of Un Laws
• To understand the concepts of constitution of human rights
• To apply the concepts of implementation of human rights

UNIT I
INTRODUCTIONS OF HUMAN RIGHTS

UNIT II
HUMAN RIGHTS EVALUATION

UNIT III
UN LAWS
Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV
HUMAN RIGHTS CONSTITUTION
Human Rights in India – Constitutional Provisions / Guarantees

UNIT V
IMPLEMENTATIONS OF HUMAN RIGHTS

TOTAL: 45 PERIODS

COURSE OUTCOME:
CO1: Understanding the basic concepts of human rights
CO2: Learning knowledge about the evaluation of human rights
CO3: Studying the concepts of UN LAWS
CO4: Understanding the concepts of constitution of human rights
CO5: Applying the concepts of implementation of human rights

REFERENCES:

CO's
<table>
<thead>
<tr>
<th></th>
<th>PO's</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</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>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</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>2</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>3</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>4</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>5</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>Avg.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PSO's
<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td>2.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CIE361 PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING

COURSE OUTCOMES:

OBJECTIVES:
• To understand the basic concepts of productivity
• To Measure and evaluate productivity

178
To Plan and implement various productivity techniques.
To apply the concepts of Reengineer the process for improving the productivity
To analyse BPR tools for improving the productivity.

UNIT I
INTRODUCTION
9
Basic concept and meaning of Productivity – Significance of Productivity – Factors affecting Productivity – Productivity cycle, Scope of Productivity Engineering and Management.

UNIT II
PRODUCTIVITY MEASUREMENT AND EVALUATION
9

UNIT III
PRODUCTIVITY PLANNING AND IMPLEMENTATION
9
Need for Productivity Planning – Short term and long term productivity planning – Productivity improvement approaches, Principles - Productivity Improvement techniques – Technology based, Material based, Employee based, Product based techniques – Managerial aspects of Productivity Implementation schedule, Productivity audit and control.

UNIT IV
REENGINEERING PROCESS
9

UNIT V
BPR TOOLS AND IMPLEMENTATION
9
Analytical and Process Tools and Techniques - Role of Information and Communication Technology in BPR – Requirements and steps in BPR Implementation – Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
The Student must be able to:
CO1: Understanding the basic concepts of productivity
CO2: Measure and evaluate productivity
CO3: Plan and implement various productivity techniques.
CO4: Reengineer the process for improving the productivity
CO5: Implement BPR tools for improving the productivity.

CO's- PO's & PSO's MAPPING

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>AVG.</td>
<td>2.4</td>
<td>8.25</td>
</tr>
</tbody>
</table>

TEXT BOOKS:

REFERENCES:

COURSE OBJECTIVES
- To understand the importance of medical equipment in hospital
- To understand the concepts of operations strategy in hospitals
- To apply the value analysis and quality control in hospitals
- To apply the latest technologies of engineering in hospitals
- To understand the importance of maintenance services in hospital

UNIT I INTRODUCTION TO MEDICAL EQUIPMENT
List of common medical equipments, Justification of purchase proposal, hospital need assessment, Equipment selection guideline, estimation of cost and planning, purchase, installation, commissioning, Replacement and buy back policy, International and indigenous standards

UNIT II OPERATIONS STRATEGY
Operations strategy a competitive tool, elements, technology selection and process: development, developing operations strategy. Operations of clinical services, supportive services, and administrative services general introduction to the various specialties, super specialties and other subspecialties

UNIT III VALUE MANAGEMENT
Value engineering, value analysis, quality control, applications in hospital

UNIT IV TECHNOLOGY MANAGEMENT IN HOSPITALS
Evolution of technology in hospitals, advanced technology in diagnostics and therapeutics, telemedicine concepts and applications, artificial intelligence and robotics in Healthcare.

UNIT V MAINTENANCE MANAGEMENT
Objectives, types of maintenance systems, equipment maintenance, quality and reliability, equipment history and documents, maintenance planning, maintenance information system, maintenance and monitoring of biomedical equipments, predictive maintenance, equipment availability, spares management, replacement policy, depreciation and loss of value, economic life, costing, cost of standby, maintenance in hospital. Bio-Medical Technology, application in hospital environment, calibration tests, maintenance features, hazards.

TOTAL: 45 PERIODS

URSE OUTCOMES
CO1: Understanding the importance of medical equipment in hospital
CO2: Understanding the concepts of operations strategy in hospitals
CO3: Applying the value analysis and quality control in hospitals
CO4: Applying the latest technologies of engineering in hospitals
CO5: Understanding the importance of maintenance services in hospital

TEXT BOOKS
2. Medical Technology, application in hospital environment, calibration tests

REFERENCES

<table>
<thead>
<tr>
<th>CO’s</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’s</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>2</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>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</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>2</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>2</td>
<td>3</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>2</td>
</tr>
<tr>
<td>Avg</td>
<td>2.5</td>
<td>2.5</td>
<td>2.5</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

CIE362 ENTREPRENEURSHIP DEVELOPMENT

OBJECTIVES:
- To understand the scope of an entrepreneur
- To study the concepts of key areas of development
- To analyze the financial assistance by the institutions
- To learn the basic concepts of methods of taxation and tax benefits
- To understand the concepts of support to entrepreneur

UNIT I ENTREPRENEURSHIP

UNIT II MOTIVATION

UNIT III BUSINESS

UNIT IV FINANCING AND ACCOUNTING
Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Network Analysis

UNIT V SUPPORT TO ENTREPRENEURS

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: Understanding of the scope of an entrepreneur
CO2: Studying the concepts of key areas of development
CO3: Analyzing the financial assistance by the institutions
CO4: Learning the basic concepts of methods of taxation and tax benefits
CO5: Understanding the concepts of support to entrepreneur

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Avg.</td>
<td>2.6</td>
<td>2.4</td>
</tr>
</tbody>
</table>

TEXT BOOKS:

REFERENCES:
OBJECTIVES:

CO1: Provide students an exposure to disasters, their significance and types.

CO2: Ensure that students begin to understand the relationship between Vulnerability, Disasters, Disaster prevention and risk reduction

CO3: Study a preliminary understanding of approaches of Disaster Risk Reduction (DRR)

CO4: Enhance awareness of institutional processes in the country and Disaster response in areas where they live, with due sensitivity

CO5: Develop rudimentary ability to respond to their surroundings with potential

UNIT I  INTRODUCTION TO DISASTERS

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, Class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, Complex emergencies, Climate change- Dos and Don’ts during various types of Disasters.

UNIT II  APPROACHES TO DISASTER RISK REDUCTION (DRR)

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Institutional Processes and Framework at State and Central Level-State Disaster Management Authority (SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III  INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, Embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous Knowledge, appropriate technology and Local resources.

UNIT IV  DISASTER RISK MANAGEMENT IN INDIA

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmers And legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V  DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

COURSE OUTCOMES:

Student will be able to

CO1  Differentiate the types of disasters, causes and their impact on environment and Society
CO2  Assess vulnerability and various methods of risk reduction measures as well as Mitigation.
CO3  Draw the hazard and vulnerability profile of India, Scenarios in the Indian context. Know the Disaster damage assessment and management.
CO4  Awareness of institutional processes in the country and to develop rudimentary
CO5  Ability to respond to their surroundings with potential disaster response in areas where they live.
Complete preparedness, response and recovery in order to reduce the impact of Disasters.

TEXT BOOKS:

REFERENCES

CO's – PO's & PSO's MAPPING

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>AVG</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
CME396  PROCESS PLANNING AND COST ESTIMATION  L  T  P  C
3  0  0  3

COURSE OBJECTIVES
1. To introduce the process planning concepts to make cost estimation for various products after process planning.
2. To learn the various Process Planning Activities.
3. To provide the knowledge of importance of costing and estimation.
4. To provide the knowledge of estimation of production costing.
5. To learn the knowledge of various Machining time calculations.

UNIT – I  INTRODUCTION TO PROCESS PLANNING  9
Introduction- methods of process planning-Drawing Interpretation-Material evaluation – steps in process selection- Production equipment and tooling selection.

UNIT – II  PROCESS PLANNING ACTIVITIES  9
Process parameters calculation for various production processes-Selection jigs and fixture selection of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies.

UNIT – III  INTRODUCTION TO COST ESTIMATION  9

UNIT – IV  PRODUCTION COST ESTIMATION  9

UNIT – V  MACHINING TIME CALCULATION  9
Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.

Total:45 periods

OUTCOMES: At the end of the course the students would be able to
1. Discuss select the process, equipment and tools for various industrial products.
2. Explain the prepare process planning activity chart.
3. Explain the concept of cost estimation.
4. Compute the job order cost for different type of shop floor.
5. Calculate the machining time for various machining operations.

TEXT BOOKS:

REFERENCES:
CIM336 MARKETING MANAGEMENT L T P C
3 0 0 3

COURSE OBJECTIVES:
- To understand the changing business environment and the fundamental premise underlying market driven strategies.
- To identify the indicators of management thoughts and practices.
- To understanding of choice of marketing mix elements and managing integrated marketing channels
- Ability to analyze the nature of consumer buying behaviour
- To understanding of the marketing research and new trends in the arena of marketing

UNIT I INTRODUCTION

UNIT II MARKETING STRATEGY

UNIT III MARKETING MIX DECISIONS

UNIT IV BUYER BEHAVIOUR
UNIT V  MARKETING RESEARCH & TRENDS IN MARKETING  9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Applied knowledge of contemporary marketing theories to the demands of business and management practice
CO2: Enhanced knowledge of marketing strategies for consumer and industrial marketing
CO3: Deep understanding of choice of marketing mix elements and managing integrated marketing channels
CO4: Ability to analyze the nature of consumer buying behaviour
CO5: Understanding of the marketing research and new trends in the area of marketing

REFERENCES:

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>AVg.</td>
<td>3</td>
<td>2.8</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES

- To learn the basic concepts of purpose of organizational behaviour
- To understand the concepts of individual behaviour
- To understand the concepts of group behaviour
- To ability to know about the leadership and behaviour
- To understand the concepts of dynamic organizational behaviour

UNIT I  FOCUS AND PURPOSE

Definition, need and importance of organizational behaviour – Nature and scope – Frame work – Organizational behaviour models.

UNIT II  INDIVIDUAL BEHAVIOUR


UNIT III  GROUP BEHAVIOUR

Organization structure – Formation – Groups in organizations – Influence – Group dynamics – Emergence of informal leaders and working norms – Group decision making techniques – Team building - Interpersonal relations – Communication – Control.

UNIT IV  LEADERSHIP AND POWER


UNIT V  DYNAMICS OF ORGANIZATIONAL BEHAVIOUR


COURSE OUTCOMES:

CO1: Learning the basic concepts of purpose of organizational behaviour
CO2: Understanding the concepts of individual behaviour
CO3: Understanding the concepts of group behaviour
CO4: Ability to know about the leadership and behaviour
CO5: Understanding the concepts of dynamic organizational behaviour

TEXT BOOKS

REFERENCES

<table>
<thead>
<tr>
<th>CO's</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's</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>3</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>
<tr>
<td>2</td>
<td>2</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>
<tr>
<td>3</td>
<td></td>
<td>2</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>
<tr>
<td>4</td>
<td>2</td>
<td>3</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>
<tr>
<td>5</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td>3</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>AVg.</td>
<td>2.3</td>
<td>2.6</td>
<td>2.5</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>
</tr>
</tbody>
</table>

CMF340 INDUSTRY 4.0  
L T P C  
3 0 0 3

COURSE OBJECTIVES:
To have systematic and comprehensive understanding on various aspects related with surface engineering of metallic components.

UNIT I INTRODUCTION  
9 Hours
Introduction- Core idea of Industry 4.0 - origin - concept of industry 4.0 - Industry 4.0 production system - current state of industry 4.0 – Technologies - How is India preparing for Industry 4.0

UNIT II A CONCEPTUAL FRAMEWORK  
9 Hours

UNIT III TECHNOLOGY ROADMAP  
9 Hours

UNIT IV ADVANCES IN ROBOTICS AND AUGMENTED REALITY  
9 Hours
Role of Augmented Reality (AR) - Introduction, AR Hardware and Software Technology, Industrial Applications of AR.
UNIT V  OBSTACLES AND FRAMEWORK CONDITIONS  9 Hours
Lack of A Digital Strategy alongside Resource Scarcity, Lack of standards and poor data security, Financing conditions, availability of skilled workers, comprehensive broadband infra-structure, state support, legal framework, protection of corporate data, liability, handling personal data.

TOTAL : 45 PERIODS

OUTCOMES:
- Upon the completion of this course the students will be able to
- Describe Industry 4.0 and scope for Indian Industry
- Demonstrate conceptual framework and road map of Industry 4.0
- Describe Robotic technology and Augmented reality for Industry 4.0
- Demonstrate obstacle and framework conditions for Industry 4.0

TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES:
- Sketch the Evolution of Management.
- Extract the functions and principles of management.
- Learn the application of the principles in an organization.
- Study the various HR related activities.
- Analyze the position of self and company goals towards business.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

UNIT II PLANNING 9

UNIT III ORGANISING 9

UNIT IV DIRECTING 9

UNIT V CONTROLLING 9
System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling.
CO2: Have same basic knowledge on international aspect of management.
CO3: Ability to understand management concept of organizing.
CO4: Ability to understand management concept of directing.
CO5: Ability to understand management concept of controlling.

TEXT BOOKS:
REFERENCES:

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AVg.</td>
<td>1.66</td>
<td>1</td>
</tr>
</tbody>
</table>

GE3752 TOTAL QUALITY MANAGEMENT L T P C 3 0 0 3

COURSE OBJECTIVES:
- Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
- Explain the TQM Principles for application.
- Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
- Describe Taguchi’s Quality Loss Function, Performance Measures and apply Techniques like QFD, TPM, COQ and BPR.
- Illustrate and apply QMS and EMS in any organization.

UNIT I INTRODUCTION 9
Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II TQM PRINCIPLES 9

UNIT III TQM TOOLS & TECHNIQUES I 9
UNIT IV  TQM TOOLS & TECHNIQUES II          9
Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function –
TPM – Concepts, improvement needs – Performance measures- Cost of Quality -
BPR.

UNIT V  QUALITY MANAGEMENT SYSTEM          9
Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-
Specific Standards - AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-
Implementation-Documentation- Internal Audits-Registration-ENVIRONMENTAL
MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of
ISO 14001—Requirements of ISO 14001-Benefits of EMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Ability to apply TQM concepts in a selected enterprise.
CO2: Ability to apply TQM principles in a selected enterprise.
CO3: Ability to understand Six Sigma and apply Traditional tools, New tools,
   Benchmarking andFMEA.
CO4: Ability to understand Taguchi’s Quality Loss Function, Performance
   Measures and apply QFD, TPM, COQ and BPR.
CO5: Ability to apply QMS and EMS in any organization.

CO’s- PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>AVg.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TEXT BOOK:

REFERENCES:
COURSE OBJECTIVES:
- Understanding the concept of Engineering Economics.
- Implement various micro economics concept in real life.
- Gaining knowledge in the field of macro economics to enable the students to have better understanding of various components of macro economics.
- Understanding the different procedures of pricing.
- Learn the various cost related concepts in micro economics.

UNIT I DEMAND & SUPPLY ANALYSIS
Managerial Economics - Relationship with other disciplines - Firms: Types, objectives and goals - Managerial decisions - Decision analysis. Demand - Types of demand - Determinants of demand - Demand function - Demand elasticity - Demand forecasting - Supply - Determinants of supply - Supply function - Supply elasticity.

UNIT II PRODUCTION AND COST ANALYSIS

UNIT III PRICING
Determinants of Price - Pricing under different objectives and different market structures - Price discrimination - Pricing methods in practice.

UNIT IV FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT)
Balance sheet and related concepts - Profit & Loss Statement and related concepts - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis - Comparative financial statements - Analysis & Interpretation of financial statements.

UNIT V CAPITAL BUDGETING (ELEMENTARY TREATMENT)
Investments - Risks and return evaluation of investment decision - Average rate of return - Payback Period - Net Present Value - Internal rate of return.

COURSE OUTCOMES: Students able to
CO1: Upon successful completion of this course, students will acquire the skills to apply the basics of economics and cost analysis to engineering and take economically sound decisions
CO2: Evaluate the economic theories, cost concepts and pricing policies
CO3: Understand the market structures and integration concepts
CO4: Understand the measures of national income, the functions of banks and concepts of globalization
CO5: Apply the concepts of financial management for project appraisal

TEXT BOOKS:
REFERENCES:
5. Dr. S. N. Maheswari and Dr. S.K. Maheshwari: Financial Accounting, Vikas, 2009

MAPPING OF COS AND POS:

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Avg.</td>
<td>2.5</td>
<td>2.4</td>
</tr>
</tbody>
</table>

GE3754 HUMAN RESOURCE MANAGEMENT L T P C
3 0 0 3

OBJECTIVE:
- To provide knowledge about management issues related to staffing,
- To provide knowledge about management issues related to training,
- To provide knowledge about management issues related to performance
- To provide knowledge about management issues related to compensation
- To provide knowledge about management issues related to human factors consideration and compliance with human resource requirements.

UNIT I INTRODUCTION TO HUMAN RESOURCE MANAGEMENT 9
The importance of human resources – Objective of Human Resource Management -
Human resource policies - Role of human resource manager.

UNIT II HUMAN RESOURCE PLANNING 9
Importance of Human Resource Planning – Internal and External sources of Human
Resources -Recruitment - Selection – Socialization.

UNIT III TRAINING AND EXECUTIVE DEVELOPMENT 9
Types of training and Executive development methods – purpose – benefits.

UNIT IV EMPLOYEE COMPENSATION 9
Compensation plan – Reward – Motivation – Career Development - Mentor – Protege
relationships.

UNIT V PERFORMANCE EVALUATION AND CONTROL 9
Performance evaluation – Feedback - The control process – Importance – Methods –
grievances –Causes – Redressal methods.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
CO1: Students would have gained knowledge on the various aspects of HRM
CO2: Students will gain knowledge needed for success as a human resources professional.
CO3: Students will develop the skills needed for a successful HR manager.
CO4: Students would be prepared to implement the concepts learned in the workplace.
CO5: Students would be aware of the emerging concepts in the field of HRM

TEXT BOOKS:

REFERENCES:

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

CO's- PO's & PSO's MAPPING

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

AVg. 2.8 2.8 1.8 2.6 2.6 2.2 1.8 1.8 2.4 1 1.4 1 1 1.4 1

GE3755 KNOWLEDGE MANAGEMENT L T P C

UNIT I INTRODUCTION
Introduction: An Introduction to Knowledge Management - The foundations of knowledge management- including cultural issues- technology applications organizational concepts and processes- management aspects- and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management - Key Challenges Facing the Evolution of Knowledge Management - Ethics for Knowledge Management.
UNIT II  CREATING THE CULTURE OF LEARNING AND KNOWLEDGE SHARING  9

UNIT III  KNOWLEDGE MANAGEMENT-THE TOOLS  9
Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Management - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval - Information Coding in the Internet Environment - Repackaging Information.

UNIT IV  KNOWLEDGE MANAGEMENT APPLICATION  9
Components of a Knowledge Strategy - Case Studies (From Library to Knowledge Center, Knowledge Management in the Health Sciences, Knowledge Management in Developing Countries).

UNIT V  FUTURE TRENDS AND CASE STUDIES  9
Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan - A case study on Corporate Memories for supporting various aspects in the process life -cycles of an organization.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the student should be able to:
CO1: Understand the process of acquiring knowledge from experts
CO2: Understand the learning organization.
CO3: Use the knowledge management tools.
CO4: Develop knowledge management Applications.
CO5: Design and develop enterprise applications.

<table>
<thead>
<tr>
<th>CO's- PO's &amp; PSO's MAPPING</th>
</tr>
</thead>
<tbody>
<tr>
<td></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>
<tr>
<td>5</td>
</tr>
<tr>
<td>AVg.</td>
</tr>
</tbody>
</table>

TEXT BOOK:

REFERENCE:
COURSE OBJECTIVES
1. To study the basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
2. To study the planning; organizing and staffing functions of management in professional organization.
3. To study the leading; controlling and decision making functions of management in professional organization.
4. To learn the organizational theory in professional organization.
5. To learn the principles of productivity and modern concepts in management in professional organization.

UNIT – I INTRODUCTION TO MANAGEMENT
Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg’s Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits.

UNIT – II FUNCTIONS OF MANAGEMENT – I
Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning– Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility – Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design.

UNIT – III FUNCTIONS OF MANAGEMENT – II
Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mounton, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics; Nature; Process; Classifications.

UNIT – IV ORGANIZATION THEORY
Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management – Maslow’s hierarchy of needs theory; Herzberg’s motivation-hygiene theory; McClelland’s three needs motivation theory; Vroom’s valence-expectancy theory – Change Management: Concept of Change; Lewin’s Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.

UNIT – V PRODUCTIVITY AND MODERN TOPICS
Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS).

TOTAL : 45 PERIODS
COURSE OUTCOMES:
At the end of the course the students would be able to
CO1 Explain basic concepts of management; approaches to management; contributors
to management studies; various forms of business organization and trade unions
function in professional organizations.
CO2 Discuss the planning; organizing and staffing functions of management in professional
organization.
CO3 Apply the leading; controlling and decision making functions of management in
professional organization.
CO4 Discuss the organizational theory in professional organization.
CO5 Apply principles of productivity and modern concepts in management in professional
organization.

TEXT BOOKS:
   New Delhi, 2009.

REFERENCES:

MAPPING OF COS AND POS:

<table>
<thead>
<tr>
<th>C O</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
MANDATORY COURSES I

MX3081 INTRODUCTION TO WOMEN AND GENDER STUDIES L T P C
3 0 0 0

COURSE OUTLINE

UNIT I CONCEPTS
Sex vs. Gender, masculinity, femininity, socialization, patriarchy, public/private, essentialism, binaryism, power, hegemony, hierarchy, stereotype, gender roles, gender relation, deconstruction, resistance, sexual division of labour.

UNIT II FEMINIST THEORY
Liberal, Marxist, Socialist, Radical, Psychoanalytic, postmodernist, ecofeminist.

UNIT III WOMEN’S MOVEMENTS: GLOBAL, NATIONAL AND LOCAL
Rise of Feminism in Europe and America. Women’s Movement in India.

UNIT IV GENDER AND LANGUAGE
Linguistic Forms and Gender. Gender and narratives.

UNIT V GENDER AND REPRESENTATION
Advertising and popular visual media.

Gender and Representation in Alternative Media. Gender and social media.

TOTAL : 45 PERIODS

MX3082 ELEMENTS OF LITERATURE L T P C
3 0 0 0

OBJECTIVE:

- To make the students aware about the finer sensibilities of human existence through an art form. The students will learn to appreciate different forms of literature as suitable modes of expressing human experience.

1. COURSE CONTENTS
Introduction to Elements of Literature

1. Relevance of literature
   a) Enhances Reading, thinking, discussing and writing skills.
   b) Develops finer sensibility for better human relationship.
   c) Increases understanding of the problem of humanity without bias.
   d) Providing space to reconcile and get a cathartic effect.

2. Elements of fiction
   a) Fiction, fact and literary truth.
   b) Fictional modes and patterns.
   c) Plot character and perspective.
3. **Elements of poetry**
   a) Emotions and imaginations.
   b) Figurative language.
   c) (Simile, metaphor, conceit, symbol, pun and irony).
   d) Personification and animation.
   e) Rhetoric and trend.

4. **Elements of drama**
   a) Drama as representational art.
   b) Content mode and elements.
   c) Theatrical performance.
   d) Drama as narration, mediation and persuasion.
   e) Features of tragedy, comedy and satire.

2. **READINGS:**

3. **OTHER SESSION:**
   4.1 *Tutorials:
   4.2 *Laboratory:
   4.3 *Project: The students will write a term paper to show their understanding of a particular piece of literature.

4. **ASSESSMENT:**
   5.1 HA:
   5.2 Quizzes-HA:
   5.3 Periodical Examination: one
   5.4 Project/Lab: one (under the guidance of the teachers the students will take a volume of poetry, fiction or drama and write a term paper to show their understanding of it in a given context; sociological, psychological, historical, autobiographical etc.
   5.5 Final Exam:

   TOTAL: 45 PERIODS

**OUTCOME OF THE COURSE:**

- Students will be able to understand the relevance of literature in human life and appreciate its aspects in developing finer sensibilities.
In this course on film appreciation, the students will be introduced broadly to the development of film as an art and entertainment form. It will also discuss the language of cinema as it evolved over a century. The students will be taught as to how to read a film and appreciate the various nuances of a film as a text. The students will be guided to study film joyfully.

**Theme - A: The Component of Films**
- A-1: The material and equipment
- A-2: The story, screenplay and script
- A-3: The actors, crew members, and the director
- A-4: The process of film making… structure of a film

**Theme - B: Evolution of Film Language**
- B-1: Film language, form, movement etc.
- B-2: Early cinema… silent film (Particularly French)
- B-3: The emergence of feature films: Birth of a Nation
- B-4: Talkies

**Theme - C: Film Theories and Criticism/Appreciation**
- C-1: Realist theory; Auteurists
- C-2: Psychoanalytic, Ideological, Feminists
- C-3: How to read films?
- C-4: Film Criticism / Appreciation

**Theme – D: Development of Films**
- D-1: Representative Soviet films
- D-2: Representative Japanese films
- D-3: Representative Italian films
- D-4: Representative Hollywood film and the studio system

**Theme - E: Indian Films**
- E-1: The early era
- E-2: The important films made by the directors
- E-3: The regional films
- E-4: The documentaries in India

**READING:**
A Reader containing important articles on films will be prepared and given to the students. The students must read them and present in the class and have discussion on these.

**MX3084 DISASTER RISK REDUCTION AND MANAGEMENT**

**COURSE OBJECTIVE**
- To impart knowledge on concepts related to disaster, disaster risk reduction, disaster management
- To acquaint with the skills for planning and organizing disaster response

**UNIT I HAZARDS, VULNERABILITY AND DISASTER RISKS**
Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Types of Disasters: Natural, Human induced, Climate change induced –Earthquake, Landslide, Flood, Drought, Fire etc – Technological disasters- Structural collapse, Industrial accidents, oil spills -Causes, Impacts including social, Economic, political, environmental, health, psychosocial, etc.- Disaster vulnerability profile of India and Tamil Nadu - Global trends in disasters: urban disasters, pandemics, Complex emergencies, - -, Inter relations between Disasters and Sustainable development Goals
UNIT II    DISASTER RISK REDUCTION (DRR)  
Sendai Framework for Disaster Risk Reduction, Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community Based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions / Urban Local Bodies (PRIs/ULBs), States, Centre, and other stakeholders- Early Warning System – Advisories from Appropriate Agencies.- Relevance of indigenous Knowledge, appropriate technology and Local resources.

UNIT III    DISASTER MANAGEMENT  
Components of Disaster Management – Preparedness of rescue and relief, mitigation, rehabilitation and reconstruction- Disaster Risk Management and post disaster management – Compensation and Insurance- Disaster Management Act (2005) and Policy - Other related policies, plans, programmers and legislation - Institutional Processes and Framework at State and Central Level- (NDMA –SDMA-DDMA-NRDF- Civic Volunteers)

UNIT IV    TOOLS AND TECHNOLOGY FOR DISASTER MANAGEMENT  

UNIT V    DISASTER MANAGEMENT: CASE STUDIES  
Discussion on selected case studies to analyse the potential impacts and actions in the contest of disasters-Landslide Hazard Zonation: Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.- Field work-Mock drill -

TOTAL : 45 PERIODS

TEXT BOOKS:
1  Taimpo (2016), Disaster Management and Preparedness, CRC Publications

REFERENCES

COURSE OUTCOME:
CO1: To impart knowledge on the concepts of Disaster, Vulnerability and Disaster Risk reduction (DRR)
CO2: To enhance understanding on Hazards, Vulnerability and Disaster Risk Assessment prevention and risk reduction
CO3: To develop disaster response skills by adopting relevant tools and technology
CO4: Enhance awareness of institutional processes for Disaster response in the country and
CO5: Develop rudimentary ability to respond to their surroundings with potential Disaster response in areas where they live, with due sensitivity
CO’s – PO’s & PSO’s MAPPING

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

Mandatory Courses II

MX3085 WELL-BEING WITH TRADITIONAL PRACTICES-YOGA, AYURVEDA SIDDHA

COURSE OBJECTIVES:
- To enjoy life happily with fun filled new style activities that help to maintain health also
- To adapt a few lifestyle changes that will prevent many health disorders
- To be cool and handbill every emotion very smoothly in every walk of life
- To learn to eat cost effective but healthy foods that are rich in essential nutrients
- To develop immunity naturally that will improve resistance against many health disorders

UNIT I HEALTH AND ITS IMPORTANCE

Health: Definition - Importance of maintaining health - More importance on prevention than treatment

Ten types of health one has to maintain - Physical health - Mental health - Social health - Financial health - Emotional health - Spiritual health - Intellectual health - Relationship health - Environmental health - Occupational/Professional health.


Causes of the above diseases / disorders - Importance of prevention of illness - Takes care of health - Improves quality of life - Reduces absenteeism - Increase satisfaction - Saves time

Simple lifestyle modifications to maintain health - Healthy Eating habits (Balanced diet according to age) Physical Activities (Stretching exercise, aerobics, resisting exercise) - Maintaining BMI-Importance and actions to be taken

UNIT II DIET

Role of diet in maintaining health - energy one needs to keep active throughout the day - nutrients one needs for growth and repair - helps one to stay strong and healthy - helps to prevent diet-related illness, such as some cancers - keeps active and - helps one to maintain a healthy
weight - helps to reduce risk of developing lifestyle disorders like diabetes – arthritis – hypertension – PCOD – infertility – ADHD – sleeplessness -helps to reduce the risk of heart diseases - keeps the teeth and bones strong.


**Food additives and their merits & demerits** - Effects of food additives - Types of food additives - Food additives and processed foods - Food additives and their reactions

**Definition of BMI and maintaining it with diet**
Importance - Consequences of not maintaining BMI - different steps to maintain optimal BM

**Common cooking mistakes**
Different cooking methods, merits and demerits of each method

**UNIT III ROLE OF AYURVEDA & SIDDHA SYSTEMS IN MAINTAINING HEALTH 4+4**
**AYUSH systems and their role in maintaining health** - preventive aspect of AYUSH - AYUSH as a soft therapy.

**Secrets of traditional healthy living** - Traditional Diet and Nutrition - Regimen of Personal and Social Hygiene - Daily routine (Dinacharya) - Seasonal regimens (Ritucharya) - basic sanitation and healthy living environment - Sadvritta (good conduct) - for conducive social life.

**Principles of Siddha & Ayurveda systems** - Macrocosm and Microcosm theory - Pancheekarana Theory / (Five Element Theory) 96 fundamental Principles - Uyir Thathukkal (Tri-Dosha Theory) - Udal Thathukkal

**Prevention of illness with our traditional system of medicine**
Primary Prevention - To decrease the number of new cases of a disorder or illness - Health promotion/education, and - Specific protective measures - Secondary Prevention - To lower the rate of established cases of a disorder or illness in the population (prevalence) - Tertiary Prevention - To decrease the amount of disability associated with an existing disorder.

**UNIT IV MENTAL WELLNESS 3+4**
**Emotional health** - Definition and types - Three key elements: the subjective experience - the physiological response - the behavioral response - Importance of maintaining emotional health - Role of emotions in daily life -Short term and long term effects of emotional disturbances - Leading a healthy life with emotions - Practices for emotional health - Recognize how thoughts influence emotions - Cultivate positive thoughts - Practice self-compassion - Expressing a full range of emotions.


**Sleep** - Sleep and its importance for mental wellness - Sleep and digestion.
**Immunity** - Types and importance - Ways to develop immunity

**UNIT V YOGA 2+12**
**Definition and importance of yoga** - Types of yoga - How to Choose the Right Kind for individuals according to their age - The Eight Limbs of Yoga - Simple yogasanas for cure and prevention of health disorders - What yoga can bring to our life.

**TOTAL : 45 PERIODS**
TEXT BOOKS:
1. Nutrition and Dietetics - Ashley Martin, Published by White Word Publications, New York, NY 10001, USA
2. Yoga for Beginners_ 35 Simple Yoga Poses to Calm Your Mind and Strengthen Your Body, by Cory Martin, Copyright © 2015 by Althea Press, Berkeley, California

REFERENCES:
2. The Mindful Self-Compassion Workbook, Kristin Neff, Ph.D Christopher Germer, Ph.D, Published by The Guilford Press A Division of Guilford Publications, Inc.370 Seventh Avenue, Suite 1200, New York, NY 10001

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4799645/
2. Simple lifestyle modifications to maintain health https://www.niddk.nih.gov/health-information/diet-nutrition/changing-habits-better-health#:~:text=Make%20your%20new%20healthy%20habit,t%20have%20time%20to%20cook.
3. Read more: https://www_legit.ng/1163909-classes-food-examples-functions.html
7. BMI https://www.hsph.harvard.edu/nutritionsource/healthy-weight/
https://www.who.int/europe/news-room/fact-sheets/item/a-healthy-lifestyle---who-recommendations
8. Yoga https://www.healthifyme.com/blog/types-of-yoga/
https://yogamedicine.com/guide-types-yoga-styles/
Ayurveda: https://vikaspedia.in/health/ayush/ayurveda-1/concept-of-healthy-living-in-ayurveda
10. CAM : https://www.hindawi.com/journals/ecam/2013/376327/
11. Preventive herbs : https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3847409/

COURSE OUTCOMES:
After completing the course, the students will be able to:
- Learn the importance of different components of health
- Gain confidence to lead a healthy life
- Learn new techniques to prevent lifestyle health disorders
- Understand the importance of diet and workouts in maintaining health
UNIT- I  CONCEPTS AND PERSPECTIVES
Meaning of History
Objectivity, Determinism, Relativism, Causation, Generalization in History; Moral judgment in history
Extent of subjectivity, contrast with physical sciences, interpretation and speculation, causation versus evidence, concept of historical inevitability, Historical Positivism.
Science and Technology—meaning, scope and importance, interaction of science, technology & society, Sources of history on science and technology in India.

UNIT- II  HISTORIOGRAPHY OF SCIENCE AND TECHNOLOGY IN INDIA
Introduction to the works of D.D. Kosambi, Dharmpal, Debiprasad Chattopadhyay, Rehman, S. Irfan Habib, Deepak Kumar, Dhruv Raina, and others.

UNIT- III  SCIENCE AND TECHNOLOGY IN ANCIENT INDIA
Technology in pre-historic period
Beginning of agriculture and its impact on technology
Science and Technology during Vedic and Later Vedic times Science and technology from 1st century AD to C-1200.

UNIT-IV  SCIENCE AND TECHNOLOGY IN MEDIEVAL INDIA
Legacy of technology in Medieval India, Interactions with Arabs
Development in medical knowledge, interaction between Unani and Ayurveda and alchemy
Astronomy and Mathematics: interaction with Arabic Sciences
Science and Technology on the eve of British conquest

UNIT-V  SCIENCE AND TECHNOLOGY IN COLONIAL INDIA
Science and the Empire
Indian response to Western Science
Growth of techno-scientific institutions

UNIT-VI  SCIENCE AND TECHNOLOGY IN A POST-INDEPENDENT INDIA
Science, Technology and Development discourse Shaping of the Science and Technology Policy
Developments in the field of Science and Technology Science and technology in globalizing India
Social implications of new technologies like the Information Technology and Biotechnology

TOTAL : 45 PERIODS
OBJECTIVES:

- This course will begin with a short overview of human needs and desires and how different political-economic systems try to fulfill them. In the process, we will end with a critique of different systems and their implementations in the past, with possible future directions.

COURSE TOPICS:

Considerations for humane society, holistic thought, human being's desires, harmony in self, harmony in relationships, society, and nature, societal systems. (9 lectures, 1 hour each)

(Refs: A Nagaraj, M K Gandhi, JC Kumarappa)

Capitalism – Free markets, demand-supply, perfect competition, laissez-faire, monopolies, imperialism. Liberal democracy. (5 lectures)

(Refs: Adam smith, J S Mill)

Fascism and totalitarianism. World war I and II. Cold war. (2 lectures)

Communism – Mode of production, theory of labour, surplus value, class struggle, dialectical materialism, historical materialism, Russian and Chinese models. (5 lectures)

(Refs: Marx, Lenin, Mao, M N Roy)

Welfare state. Relation with human desires. Empowered human beings, satisfaction. (3 lectures)

Gandhian thought. Swaraj, Decentralized economy & polity, Community. Control over one's lives. Relationship with nature. (6 lectures)

(Refs: M K Gandhi, Schumacher, Kumarappa)

Essential elements of Indian civilization. (3 lectures)

(Refs: Pt Sundarlal, R C Mazumdar, Dharampal)

Technology as driver of society, Role of education in shaping of society. Future directions. (4 lectures) (Refs: Nandkishore Acharya, David Dixon, Levis Mumford)

Conclusion (2 lectures)

Total lectures: 39

Preferred Textbooks: See Reference Books

Reference Books: Authors mentioned along with topics above. Detailed reading list will be provided.

GRADING:

- Mid sems
- End sem
- Home Assign
- Term paper

TOTAL : 45 PERIODS
OUTCOME:
- The students will get an understanding of how societies are shaped by philosophy, political and economic system, how they relate to fulfilling human goals & desires with some case studies of how different attempts have been made in the past and how they have fared.

MX3088                      STATE, NATION BUILDING AND POLITICS IN INDIA                    L T P C
                                           3  0  0  0

OBJECTIVE:
The objective of the course is to provide an understanding of the state, how it works through its main organs, primacy of politics and political process, the concept of sovereignty and its changing contours in a globalized world. In the light of this, an attempt will be made to acquaint the students with the main development and legacies of national movement and constitutional development in India, reasons for adopting a Parliamentary-federal system, the broad philosophy of the Constitution of India and the changing nature of Indian Political System. Challenges/ problems and issues concerning national integration and nation-building will also be discussed in the contemporary context with the aim of developing a future vision for a better India.

TOPICS:
Understanding the need and role of State and politics.
Development of Nation-State, sovereignty, sovereignty in a globalized world.
Organs of State – Executive, Legislature, Judiciary. Separation of powers, forms of government-unitary-federal, Presidential-Parliamentary,
The idea of India.

1857 and the national awakening.

1885 Indian National Congress and development of national movement – its legacies. Constitution making and the Constitution of India.
Goals, objective and philosophy. Why a federal system?
National integration and nation-building.

Challenges of nation-building – State against democracy (Kothari) New social movements.
The changing nature of Indian Political System, the future scenario. What can we do?

OUTCOME OF THE COURSE:
It is expected that this course will make students aware of the theoretical aspect of the state, its organs, its operationalization aspect, the background and philosophy behind the founding of the present political system, broad streams and challenges of national integration and nation-building in India. It will equip the students with the real understanding of our political system/ process in correct perspective and make them sit up and think for devising ways for better participation in the system with a view to making the governance and delivery system better for the common man who is often left unheard and unattended in our democratic setup besides generating a lot of dissatisfaction and difficulties for the system.

SUGGESTED READING:

TOTAL : 45 PERIODS

MX3089 INDUSTRIAL SAFETY

OBJECTIVES
- To Understand the Introduction and basic Terminologies safety.
- To enable the students to learn about the Important Statutory Regulations and standards.
- To enable students to Conduct and participate the various Safety activities in the Industry.
- To have knowledge about Workplace Exposures and Hazards.
- To assess the various Hazards and consequences through various Risk Assessment Techniques.

UNIT I SAFETY TERMINOLOGIES
Hazard-Types of Hazard- Risk-Hierarchy of Hazards Control Measures-Lead indicators- lag Indicators-Flammability- Toxicity Time-weighted Average (TWA) - Threshold LimitValue (TLV) - Short Term Exposure Limit (STEL)- Immediately dangerous to life or health (IDLH)- acute and chronic Effects- Routes of Chemical Entry-Personnel Protective Equipment- Health and Safety Policy-Material Safety Data Sheet MSDS

UNIT II STANDARDS AND REGULATIONS

UNIT III SAFETY ACTIVITIES

UNIT IV WORKPLACE HEALTH AND SAFETY
Noise hazard- Particulate matter- musculoskeletal disorder improper sitting poster and lifting Ergonomics RULE & REBA- Unsafe act & Unsafe Condition- Electrical Hazards- Crane Safety- Toxic gas Release

UNIT V HAZARD IDENTIFICATION TECHNIQUES
Job Safety Analysis-Preliminary Hazard Analysis-Failure mode and Effects Analysis- Hazard and Operability- Fault Tree Analysis- Event Tree Analysis Qualitative and Quantitative Risk Assessment- Checklist Analysis- Root cause analysis- What-If Analysis- and Hazard Identification and Risk Assessment

Course outcomes on completion of this course the student will be able:
- Understand the basic concept of safety.
- Obtain knowledge of Statutory Regulations and standards.
- Know about the safety Activities of the Working Place.
- Analyze on the impact of Occupational Exposures and their Remedies
- Obtain knowledge of Risk Assessment Techniques.
TEXTBOOKS
2. L. M. Deshmukh Industrial Safety Management: Hazard Identification and Risk Control McGraw-Hill Education

REFERENCES
5. Society of Safety Engineers, USA

ONLINE RESOURCES

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Understand the basic concept of safety.</td>
<td>PO1 3 PO2 3 PO3 1 PO4 1 PO5 3 PO6 2 PO7 2 PO8 3 PO9 1 PO10 3 PO11 3 PO12 3</td>
</tr>
<tr>
<td>CO2</td>
<td>Obtain knowledge of Statutory Regulations and standards.</td>
<td>PO1 2 PO2 3 PO3 2 PO4 2 PO5 3 PO6 3 PO7 2 PO8 3 PO9 1 PO10 3 PO11 3 PO12 3</td>
</tr>
<tr>
<td>CO3</td>
<td>Know about the safety Activities of the Working Place.</td>
<td>PO1 2 PO2 2 PO3 2 PO4 1 PO5 2 PO6 2 PO7 3 PO8 2 PO9 1 PO10 3 PO11 3 PO12 3</td>
</tr>
<tr>
<td>CO4</td>
<td>Analyze on the impact of Occupational Exposures and their Remedies</td>
<td>PO1 3 PO2 3 PO3 2 PO4 2 PO5 3 PO6 2 PO7 3 PO8 2 PO9 1 PO10 3 PO11 3 PO12 3</td>
</tr>
<tr>
<td>CO5</td>
<td>Obtain knowledge of Risk Assessment Techniques.</td>
<td>PO1 3 PO2 2 PO3 2 PO4 3 PO5 2 PO6 3 PO7 3 PO8 3 PO9 2 PO10 3 PO11 3 PO12 3</td>
</tr>
<tr>
<td>Industrial safety</td>
<td>PO1 3 PO2 3 PO3 2 PO4 1 PO5 3 PO6 2 PO7 3 PO8 2 PO9 1 PO10 3 PO11 3 PO12 3</td>
<td></td>
</tr>
</tbody>
</table>
OBJECTIVES:
The main objectives of this course are to:
1. Understand the importance, principles, and search methods of AI
2. Provide knowledge on predicate logic and Prolog.
3. Introduce machine learning fundamentals
4. Study of supervised learning algorithms.
5. Study about unsupervised learning algorithms.

UNIT I INTELLIGENT AGENT AND UNINFORMED SEARCH 6

UNIT II PROBLEM SOLVING WITH SEARCH TECHNIQUES 6
Informed Search - Greedy Best First - A* algorithm - Adversarial Game and Search - Game theory - Optimal decisions in game - Min Max Search algorithm - Alpha-beta pruning - Constraint Satisfaction Problems (CSP) - Examples - Map Coloring - Job Scheduling - Backtracking Search for CSP

UNIT III LEARNING 6
Machine Learning: Definitions – Classification - Regression - approaches of machine learning models - Types of learning - Probability - Basics - Linear Algebra – Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, Bias and Variance - Regression: Linear Regression - Logistic Regression

UNIT IV SUPERVISED LEARNING 6

UNIT V UNSUPERVISED LEARNING 6
Unsupervised Learning – Principle Component Analysis - Neural Network: Fixed Weight Competitive Nets - Kohonen Self-Organizing Feature Maps – Clustering: Definition - Types of Clustering – Hierarchical clustering algorithms – k-means algorithm

PRACTICAL EXERCISES: 30 PERIODS
Programs for Problem solving with Search
1. Implement breadth first search
2. Implement depth first search
3. Analysis of breadth first and depth first search in terms of time and space
4. Implement and compare Greedy and A* algorithms.

Supervised learning
5. Implement the non-parametric locally weighted regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs
6. Write a program to demonstrate the working of the decision tree based algorithm.
7. Build an artificial neural network by implementing the back propagation algorithm and test the same using appropriate data sets.
8. Write a program to implement the naïve Bayesian classifier.

**Unsupervised learning**
9. Implementing neural network using self-organizing maps
10. Implementing k-Means algorithm to cluster a set of data.
11. Implementing hierarchical clustering algorithm.

*Note:*
- Installation of gnu-prolog, Study of Prolog (gnu-prolog).
- The programs can be implemented in using C++/JAVA/ Python or appropriate tools can be used by designing good user interface
- Data sets can be taken from standard repositories (https://archive.ics.uci.edu/ml/datasets.html) or constructed by the students.

**OUTCOMES:**
CO1: Understand the foundations of AI and the structure of Intelligent Agents
CO2: Use appropriate search algorithms for any AI problem
CO3: Study of learning methods
CO4: Solving problem using Supervised learning
CO5: Solving problem using Unsupervised learning

**TEXT BOOKS:**
2. S.N.Sivanandam and S.N.Deepa, Principles of soft computing-Wiley India.3 rd ed

**REFERENCES**

**OCS352 IOT CONCEPTS AND APPLICATIONS**

**OBJECTIVES:**
- To apprise students with basic knowledge of IoT that paves a platform to understand physical and logical design of IoT
- To teach a student how to analyse requirements of various communication models and protocols for cost-effective design of IoT applications on different IoT platforms.
- To introduce the technologies behind Internet of Things(IoT).
- To explain the students how to code for an IoT application using Arduino/Raspberry Pi open platform.
- To apply the concept of Internet of Things in real world scenario.

**UNIT I INTRODUCTION TO INTERNET OF THINGS**
UNIT II  COMPONENTS IN INTERNET OF THINGS  5
Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee, Wifi, GPS, GSM Modules)

UNIT III  PROTOCOLS AND TECHNOLOGIES BEHIND IOT  6

UNIT IV  OPEN PLATFORMS AND PROGRAMMING  7

UNIT V  IOT APPLICATIONS  7
Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture

PRACTICAL EXERCISES: 30 PERIODS
1. Introduction to Arduino platform and programming
2. Interfacing Arduino to Zigbee module
3. Interfacing Arduino to GSM module
4. Interfacing Arduino to Bluetooth Module
5. Introduction to Raspberry Pi platform and python programming
6. Interfacing sensors to Raspberry Pi
7. Communicate between Arduino and Raspberry PI using any wireless medium
8. Setup a cloud platform to log the data
9. Log Data using Raspberry PI and upload to the cloud platform
10. Design an IOT based system

OUTCOMES:
CO 1: Explain the concept of IoT.
CO 2: Understand the communication models and various protocols for IoT.
CO 3: Design portable IOT using Arduino/Raspberry Pi /open platform
CO 4: Apply data analytics and use cloud offerings related to IoT.
CO 5: Analyze applications of IoT in real time scenario.

TOTAL: 60 PERIODS

TEXTBOOKS

REFERENCES
1. Perry Lea, “Internet of things for architects”, Packt, 2018

OCS353 DATA SCIENCE FUNDAMENTALS L T P C 2 0 2 3

COURSE OBJECTIVES:
- Familiarize students with the data science process.
- Understand the data manipulation functions in Numpy and Pandas.
- Explore different types of machine learning approaches.
- Understand and practice visualization techniques using tools.
- Learn to handle large volumes of data with case studies.

UNIT I INTRODUCTION 6
Data Science: Benefits and uses – facets of data - Data Science Process: Overview – Defining research goals – Retrieving data – data preparation - Exploratory Data analysis – build the model – presenting findings and building applications - Data Mining - Data Warehousing – Basic statistical descriptions of Data

UNIT II DATA MANIPULATION 9

UNIT III MACHINE LEARNING 5
The modeling process - Types of machine learning - Supervised learning - Unsupervised learning - Semi-supervised learning - Classification, regression - Clustering - Outliers and Outlier Analysis

UNIT IV DATA VISUALIZATION 5

UNIT V HANDLING LARGE DATA 5
Problems - techniques for handling large volumes of data - programming tips for dealing with large data sets- Case studies: Predicting malicious URLs, Building a recommender system - Tools and techniques needed - Research question - Data preparation - Model building – Presentation and automation.

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

LAB EXERCISES
1. Download, install and explore the features of Python for data analytics.
2. Working with Numpy arrays
3. Working with Pandas data frames
4. Basic plots using Matplotlib
5. Statistical and Probability measures
   a) Frequency distributions
   b) Mean, Mode, Standard Deviation
   c) Variability
   d) Normal curves

215
e) Correlation and scatter plots
f) Correlation coefficient
g) Regression

6. Use the standard benchmark data set for performing the following:
a) Univariate Analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation, Skewness and Kurtosis.
b) Bivariate Analysis: Linear and logistic regression modelling.
7. Apply supervised learning algorithms and unsupervised learning algorithms on any data set.
8. Apply and explore various plotting functions on any data set.

Note: Example data sets like: UCI, Iris, Pima Indians Diabetes etc.

COURSE OUTCOMES:
At the end of this course, the students will be able to:
   CO1: Gain knowledge on data science process.
   CO2: Perform data manipulation functions using Numpy and Pandas.
   CO3: Understand different types of machine learning approaches.
   CO4: Perform data visualization using tools.
   CO5: Handle large volumes of data in practical scenarios.

TEXT BOOKS

REFERENCES

CCS333 AUGMENTED REALITY/VIRTUAL REALITY  L T P C
2 0 2 3

OBJECTIVES:
• To impart the fundamental aspects and principles of AR/VR technologies.
• To know the internals of the hardware and software components involved in the development of AR/VR enabled applications.
• To learn about the graphical processing units and their architectures.
• To gain knowledge about AR/VR application development.
• To know the technologies involved in the development of AR/VR based applications.

UNIT I INTRODUCTION

UNIT II VR MODELING

UNIT III VR PROGRAMMING
VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D

UNIT IV APPLICATIONS

UNIT V AUGMENTED REALITY
Introduction to Augmented Reality-Computer vision for AR-Interaction-Modelling and Annotation-Navigation-Wearable devices

PRACTICAL EXERCISES:
1. Study of tools like Unity, Maya, 3DS MAX, AR toolkit, Vuforia and Blender.
2. Use the primitive objects and apply various projection types by handling camera.
3. Download objects from asset store and apply various lighting and shading effects.
4. Model three dimensional objects using various modelling techniques and apply textures over them.
5. Create three dimensional realistic scenes and develop simple virtual reality enabled mobile applications which have limited interactivity.
6. Add audio and text special effects to the developed application.
7. Develop VR enabled applications using motion trackers and sensors incorporating full haptic interactivity.
8. Develop AR enabled applications with interactivity like E learning environment, Virtual walkthroughs and visualization of historic places.
10. Develop simple MR enabled gaming applications.

TOTAL:60 PERIODS

OUTCOMES:
On completion of the course, the students will be able to:
CO1: Understand the basic concepts of AR and VR
CO2: Understand the tools and technologies related to AR/VR
CO3: Know the working principle of AR/VR related Sensor devices
CO4: Design of various models using modeling techniques
CO5: Develop AR/VR applications in different domains

TEXT BOOKS:
1. Charles Palmer, John Williamson, “Virtual Reality Blueprints: Create compelling VR experiences for mobile”, Packt Publisher, 2018

OPEN ELCTIVE III

OHS351 ENGLISH FOR COMPETITIVE EXAMINATIONS L T P C
3 0 0 3

COURSE DESCRIPTION:
Students aspiring to take up competitive exams of which the English language is a vital component will find this course useful. Designed for students in the higher semesters, the course will help students to familiarise themselves with those aspects of English that are tested in these examinations.

Objectives:
• To train the students in the language components essential to face competitive examinations both at the national (UPSC, Banking, Railway, Defence) and the international level (GRE, TOEFL, IELTS).
• To enhance an awareness of the specific patterns in language testing and the respective skills to tackle verbal reasoning and verbal ability tests.
• To inculcate effective practices in language-learning in order to improve accuracy in usage of grammar and coherence in writing.
• To improve students’ confidence to express their ideas and opinions in formal contexts
• To create awareness of accuracy and precision in communication

UNIT I

UNIT II

UNIT III

UNIT IV

TOTAL: 45 PERIODS

LEARNING OUTCOMES:
At the end of the course, learners will be able
- Expand their vocabulary and gain practical techniques to read and comprehend a wide range of texts with the emphasis required
- Identify errors with precision and write with clarity and coherence
- Understand the importance of task fulfilment and the usage of task-appropriate vocabulary
- Communicate effectively in group discussions, presentations and interviews
- Write topic based essays with precision and accuracy

CO-PO & PSO MAPPING

| CO | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | PSO | 1 | 2 | 3 |
|----|---|---|---|---|---|---|---|---|---|----|----|----|----|----|---|---|---|
| 1  | 1 | 1 | 3 | 3 | 1 | 3 | 3 | 3 | 1 | 3 | 1 | 3 | - | - | - |
| 2  | 2 | 3 | 3 | 3 | 2 | 3 | 3 | 3 | 3 | 1 | 3 | 3 | 3 | - | - | - |
| 3  | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | - | - | - |
| 4  | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | - | - | - |
| 5  | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 3 | 3 | - | - | - |
| AVg. | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | 2.6 | - | - | - |

1-low, 2-medium, 3-high, '-'- no correlation

Note: The average value of this course to be used for program articulation matrix.

Teaching Methods:
Instructional methods will involve discussions, taking mock tests on various question papers – Objective, multiple-choice and descriptive. Peer evaluation, self-check on improvement and peer feedback - Practice sessions on speaking assessments, interview and discussion – Using multimedia.

Evaluative Pattern:
Internal Tests – 50%
End Semester Exam - 50%

TEXT BOOKS:

REFERENCES:

Websites
http://civilservicesmentor.com/, http://www.educationobserver.com
http://www.cambridgeenglish.org/in/
COURSE OBJECTIVES

- To understand the importance of sustainable development
- To acquire a reasonable knowledge on the legal frameworks pertaining to pollution control and environmental management
- To comprehend the role of NGOs in attaining sustainable development

UNIT I   ENVIRONMENTAL CONCERNS
Introduction to sustainable development goals, Global responsibility of environmental concern, Importance of environmental preservation, Environmental threats, Pollution and its types, Effects of Pollution, Pollution control, Treatment of wastes

UNIT II   ROLE OF NGOS
Role of NGO’s in national development, NGO’s and participatory management, Challenges and limitations of NGO’s, Community Development programmes, Role of NGO’s in Community Development programmes, Participation of NGO’s in environment management, Corporate Social responsibility, NGO’s and corporate social responsibility

UNIT III   SUSTAINABLE DEVELOPMENT
Issues and Challenges of Sustainable Development, Bioenergy, Sustainable Livelihoods and Rural Poor in Sustainable Development, Protecting ecosystem services for sustainable development, Non-renewable sources of energy and its effect, Renewable sources of energy for sustainability, Nuclear resources and Legal Regulation of Hazardous Substances, Sustainable Development: Programme and Policies, Sustainability assessment and Indicators

UNIT IV   NGO’S FOR SUSTAINABILITY
Civil Society Initiatives in Environment Management, Civil Society Initiatives for Sustainable Development, Global Initiatives in Protecting Global Environment, World Summit on Sustainable Development (Johannesburg Summit 2002), Ecological economics, Environmental sustainability, Social inclusion, Health for all, education for all, Food security and Water security, NGOs and Sustainable Development strategies

UNIT V   LEGAL FRAMEWORKS
Need for a Legal framework and its enforcement, Legal measures to control pollution, Environmental Legislations in India, Mechanism to implement Environmental Laws in India, Legal Protection of Forests Act 1927, Legal Protection of Wild Life, Role of NGO’s in implementing environmental laws, Challenges in the implementation of environmental legislation

TOTAL 45 : PERIODS

OUTCOMES
Upon completion of this course, the student will:
CO1 Have a thorough grounding on the issues and challenges being faced in attaining sustainable development
CO2 Have a knowledge on the role of NGOs towards sustainable development
CO 3 Present strategies for NGOs in attaining sustainable development
CO 4 recognize the importance of providing energy, food security and health equity to all members of the society without damaging the environment
CO 5 understand the environmental legislations
REFERENCE BOOKS

OMG353 DEMOCRACY AND GOOD GOVERNANCE

UNIT-I
Structure and Process of Governance: Indian Model of Democracy, Parliament, Party Politics and Electoral Behaviour, Federalism, the Supreme Court and Judicial Activism, Units of Local Governance

UNIT-II
Regulatory Institutions – SEBI, TRAI, Competition Commission of India,

UNIT-III
Lobbying Institutions: Chambers of Commerce and Industries, Trade Unions, Farmers Associations, etc.

UNIT- IV
Contemporary Political Economy of Development in India: Policy Debates over Models of Development in India, Recent trends of Liberalisation of Indian Economy in different sectors, E-governance

UNIT-V
Dynamics of Civil Society: New Social Movements, Role of NGO’s, Understanding the political significance of Media and Popular Culture.

REFERENCES:
4. Saima Saeed: Screening the Public Sphere: Media and Democracy in India,2013
COURSE OBJECTIVES

1. To know the Indian and global energy scenario.
2. To learn the various solar energy technologies and its applications.
3. To educate the various wind energy technologies.
4. To explore the various bio-energy technologies.
5. To study the ocean and geothermal technologies.

UNIT – I  ENERGY SCENARIO
Indian energy scenario in various sectors – domestic, industrial, commercial, agriculture, transportation and others – Present conventional energy status – Present renewable energy status- Potential of various renewable energy sources-Global energy status-Per capita energy consumption - Future energy plans

UNIT – II  SOLAR ENERGY

UNIT – III  WIND ENERGY

UNIT – IV  BIO-ENERGY

UNIT – V  OCEAN AND GEOTHERMAL ENERGY

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course the students would be able to
- Discuss the Indian and global energy scenario.
- Describe the various solar energy technologies and its applications.
- Explain the various wind energy technologies.
- Explore the various bio-energy technologies.
- Discuss the ocean and geothermal technologies.

TEXT BOOKS:
REFERENCES:

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

Low (1); Medium (2); High (3)

OME354 APPLIED DESIGN THINKING L T P C
3 0 0 3

OBJECTIVES:
The course aims to
- Introduce tools & techniques of design thinking for innovative product development
- Illustrate customer-centric product innovation using simple use cases
- Demonstrate development of Minimum usable Prototypes
- Outline principles of solution concepts & their evaluation
- Describe system thinking principles as applied to complex systems

UNIT I DESIGN THINKING PRINCIPLES
Exploring Human-centered Design - Understanding the innovation process, discovering areas of opportunity, Interviewing & empathy-building techniques, Mitigate validation risk with FIR [Forge Innovation rubric] - Case studies

UNIT II ENDUSER-CENTRIC INNOVATION
Importance of customer-centric innovation - Problem Validation and Customer Discovery - Understanding problem significance and problem incidence - Customer Validation. Target user, User persona & user stories. Activity: Customer development process - Customer interviews and field visit

UNIT III APPLIED DESIGN THINKING TOOLS
Concept of Minimum Usable Prototype [MUP] - MUP challenge brief - Designing & Crafting the value proposition - Designing and Testing Value Proposition; Design a compelling value proposition; Process, tools and techniques of Value Proposition Design

UNIT IV CONCEPT GENERATION
Solution Exploration, Concepts Generation and MUP design- Conceptualize the solution concept; explore, iterate and learn; build the right prototype; Assess capability, usability and feasibility. Systematic concept generation; evaluation of technology alternatives and the solution concepts
UNIT V SYSTEM THINKING
System Thinking, Understanding Systems, Examples and Understandings, Complex Systems

TOTAL: 45 PERIODS

COURSE OUTCOMES
At the end of the course, learners will be able to:
• Define & test various hypotheses to mitigate the inherent risks in product innovations.
• Design the solution concept based on the proposed value by exploring alternate solutions to achieve value-price fit.
• Develop skills in empathizing, critical thinking, analyzing, storytelling & pitching
• Apply system thinking in a real-world scenario

TEXT BOOKS
1. Steve Blank, (2013), The four steps to epiphany: Successful strategies for products that win, Wiley.
3. Proposition Design: How to Create Products and Services Customers Want, Wiley

REFERENCES
1. https://www.ideou.com/pages/design-thinking#process
4. https://blog.forgeforward.in/evaluating-product-innovations-e8178e58b86e
6. https://blog.forgeforward.in/star-up-failure-is-like-true-lie-7812cffee9b85

MF3003 REVERSE ENGINEERING LT P C
3 0 0 3

COURSE OBJECTIVES:
• The main learning objective of this course is to prepare students for:
• Applying the fundamental concepts and principles of reverse engineering in product design and development.
• Applying the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
• Applying the concept and principles of material identification and process verification in reverse engineering of product design and development.
• Analysing the various legal aspect and applications of reverse engineering in product design and development.
• Understand about 3D scanning hardware & software operations and procedure to generate 3D model
UNIT I
INTRODUCTION & GEOMETRIC FORM 9

UNIT II
MATERIAL CHARACTERISTICS AND PROCESS IDENTIFICATION 9

UNIT III
DATA PROCESSING 9
Hours

UNIT IV
3D SCANNING AND MODELLING 9
Hours

UNIT V
INDUSTRIAL APPLICATIONS 9
Hours

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
- Apply the fundamental concepts and principles of reverse engineering in product design and development.
- Apply the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
- Apply the concept and principles of material identification and process verification in reverse engineering of product design and development.
- Apply the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.
- Analyze the various legal aspect
- Applications of reverse engineering in product design and development.

TEXT BOOKS:

REFERENCES:
OPR351  SUSTAINABLE MANUFACTURING

LTPC  3 0 0 3

COURSE OBJECTIVES:

- To be acquainted with sustainability in manufacturing and its evaluation.
- To provide knowledge in environment and social sustainability.
- To provide the student with the knowledge of strategy to achieve sustainability.
- To familiarize with trends in sustainable operations.
- To create awareness in current sustainable practices in manufacturing industry.

UNIT – I  ECONOMIC SUSTAINABILITY


UNIT – II  SOCIAL AND ENVIRONMENTAL SUSTAINABILITY

Social sustainability – Introduction-Work management -Human rights - Societal commitment - Customers -Business practices -Modelling and assessing social sustainability. Environmental issues pertaining to the manufacturing sector: Pollution - Use of resources -Pressure to reduce costs - Environmental management: Processes that minimize negative environmental impacts - environmental legislation and energy costs - need to reduce the carbon footprint of manufacturing Operations-Modelling and assessing environmental sustainability

UNIT – III  SUSTAINABILITY PRACTICES

Sustainability awareness - Measuring Industry Awareness-Drivers and barriers -Availability of sustainability indicators -Analysis of sustainability practicing -Modeling and assessment of sustainable practicing -Sustainability awareness -Sustainability drivers and barriers - Availability of sustainability indicators- Designing questionnaires- Optimizing Sustainability Indexes-Elements –Cost and time model.

UNIT – IV  MANUFACTURING STRATEGY FOR SUSTAINABILITY

Concepts of competitive strategy and manufacturing strategies and development of a strategic improvement programme - Manufacturing strategy in business success strategy formulation and formulation - Structured strategy formulation - Sustainable manufacturing system design options - Approaches to strategy formulation - Realization of new strategies/system designs.

UNIT – V  TRENDS IN SUSTAINABLE OPERATIONS


TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Discuss the importance of economic sustainability.
CO2: Describe the importance of sustainable practices.
CO3: Identify drivers and barriers for the given conditions.
CO4: Formulate strategy in sustainable manufacturing.
CO5: Plan for sustainable operation of industry with environmental, cost consciousness.

TEXT BOOKS:

REFERENCES:

Mapping of COs with POs and PSOs

<table>
<thead>
<tr>
<th>COs/Pos &amp; PSOs</th>
<th>POs 3 4 5 6 7 8 9 10 11 12</th>
<th>PSOs 1 2 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3 - 2 - - - 2 2 - 1 1 2 2 2 1</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3 - - - - 2 - - 1 1 2 1 2 2 2</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3 - - - - 2 3 - 1 1 2 1 2 2 2</td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3 - 3 - - 2 - - 1 1 2 2 2 1</td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3 - 3 - - 2 2 - 1 1 2 2 2 1</td>
<td></td>
</tr>
<tr>
<td>CO/PO &amp; PSO Average</td>
<td>3 - 3 - - 2 2 - 1 1 2 2 2 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 – Slight, 2 – Moderate, 3 – Substantial</td>
<td></td>
</tr>
</tbody>
</table>

OAS352 SPACE ENGINEERING

OBJECTIVES:
- Use the standard atmosphere tables and equations.
- Find lift and drag coefficient data from NACA plots.
- Apply the concept of static stability to flight vehicles.
- Describe the concepts of stress, strain, Young’s modulus, Poisson’s ratio, yield strength.
- Demonstrate a basic knowledge of dynamics relevant to orbital mechanics.

UNIT I STANDARD ATMOSPHERE 6
History of aviation – standard atmosphere - pressure, temperature and density altitude.

UNIT II AERODYNAMICS 10
Aerodynamic forces – Lift generation Viscosity and its implications - Shear stress in a velocity profile - Lagrangian and Eulerian flow field - Concept of a streamline – Aircraft terminology and geometry - Aircraft types - Lift and drag coefficients using NACA data.
UNIT III PERFORMANCE AND PROPULSION 9
Viscous and pressure drag - flow separation - aerodynamic drag - thrust calculations - thrust/power available and thrust/power required.

UNIT IV AIRCRAFT STABILITY AND STRUCTURAL THEORY 10

UNIT V SPACE APPLICATIONS 10
History of space research - spacecraft trajectories and basic orbital manoeuvres - six orbital elements - Kepler’s laws of orbits - Newton’s law of gravitation.

TOTAL: 45 PERIODS

OUTCOMES:
- Illustrate the history of aviation & developments over the years
- Ability to identify the types & classifications of components and control systems
- Explain the basic concepts of flight & Physical properties of Atmosphere
- Identify the types of fuselage and constructions.
- Distinguish the types of Engines and explain the principles of Rocket

TEXT BOOKS:

REFERENCE:

OIM351 INDUSTRIAL MANAGEMENT L T P C 3 0 0 3

COURSE OBJECTIVES:
- To introduce fundamental concepts of industrial management
- To understand the approaches to the study of Management
- To learn about Decision Making, Organizing and leadership
- To analyze the Managerial Role and functions
- To know about the Supply Chain Management

UNIT I INTRODUCTION 9

UNIT II FUNCTIONS OF MANAGEMENT 9

UNIT III ORGANIZATIONAL BEHAVIOUR

UNIT IV GROUPDYNAMICS

UNIT V MODERN CONCEPTS
Management by Objectives (MBO) - Management by Exception (MBE),Strategic Management - Planning for Future direction - SWOT Analysis -Evolving development strategies, information technology in management Decisions support system-Management Games Business Process Re-engineering(BPR) –Enterprises Resource Planning (ERP) - Supply Chain Management (SCM) - Activity Based Management (AM) - Global Perspective - Principles and Steps Advantages and disadvantage

COURSE OUTCOMES:
CO1: Understand the basic concepts of industrial management
CO2: Identify the group conflicts and its causes.
CO3: Perform swot analysis
CO4 : Analyze the learning curves
CO5 : Understand the placement and performance appraisal

REFERENCES:

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2.2</td>
<td>2.3</td>
</tr>
<tr>
<td>AVG</td>
<td>1.8</td>
<td>2</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES

- Developing a clear knowledge in the basics of various quality concepts.
- Facilitating the students in understanding the application of control charts and its techniques.
- Developing the special control procedures for service and process-oriented industries.
- Analyzing and understanding the process capability study.
- Developing the acceptance sampling procedures for incoming raw material.

UNIT I INTRODUCTION


UNIT II CONTROL CHARTS

Chance and assignable causes of process variation, statistical basis of the control chart, control charts for variables- X, R and S charts, attribute control charts - p, np, c and u- Construction and application.

UNIT III SPECIAL CONTROL PROCEDURES

Warning and modified control limits, control chart for individual measurements, multi-varoi chart, X chart with a linear trend, chart for moving averages and ranges, cumulative-sum and exponentially weighted moving average control charts.

UNIT IV STATISTICAL PROCESS CONTROL

Process stability, process capability analysis using a Histogram or probability plots and control chart. Gauge capability studies, setting specification limits.

UNIT V ACCEPTANCE SAMPLING

The acceptance sampling fundamental, OC curve, sampling plans for attributes, simple, double, multiple and sequential, sampling plans for variables, MIL-STD-105D and MIL-STD-414E & IS2500 standards.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Students will be able to:

CO1: Control the quality of processes using control charts for variables in manufacturing industries.

CO2: Control the occurrence of defective product and the defects in manufacturing companies.

CO3: Control the occurrence of defects in services.

CO4: Analyzing and understanding the process capability study.

CO5: Developing the acceptance sampling procedures for incoming raw material.

CO's- PO's & PSO's MAPPING

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>AVg.</td>
<td>2.6</td>
<td>2.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>AVg.</td>
<td>2.7</td>
<td>2.7</td>
<td></td>
</tr>
</tbody>
</table>

230
COURSE OBJECTIVES
1: To enable the students to acquire knowledge of Fire and Safety Studies
2: To learn about the effect of fire on materials used for construction, the method of test for non-combustibility & fire resistance
3: To learn about fire area, fire stopped areas and different types of fire-resistant doors
4: To learn about the method of fire protection of structural members and their repair due to fire damage.
5: To develop safety professionals for both technical and management through systematic and quality-based study programmes

UNIT I  INHERENT SAFETY CONCEPTS
Compartment fire-factors controlling fire severity, ventilation controlled and fuel controlled fires; Spread of fire in rooms, within building and between buildings. Effect of temperature on the properties of structural materials - concrete, steel, masonry and wood; Behavior of non-structural materials on fire - plastics, glass, textile fibres and other house hold materials.

UNIT II  PLANT LOCATIONS
Compartment temperature-time response at pre-flashover and post flashover periods; Equivalence of fire severity of compartment fire and furnace fire; Fire resistance test on structural elements - standard heating condition, Indian standard test method, performance criteria.

UNIT III  WORKING CONDITIONS
Fire separation between building - principle of calculation of safe distance. Design principles of fire resistant walls and ceilings; Fire resistant screens - solid screens and water curtains; Local barriers; Fire stopped areas-in roof, in fire areas and in connecting structures; Fire doors - Low combustible, Non-combustible and Spark-proof doors; method of suspension of fire doors; Air-tight sealing of doors;

UNIT IV  FIRE SEVERITY AND REPAIR TECHNIQUES
Fabricated fire proof boards-calcium silicate, Gypsum, Vermiculite, and Perlite boards; Fire protection of structural elements - Wooden, Steel and RCC.. Reparability of fire damaged structures- Assessment of damage to concrete, steel, masonry and timber structures, Repair techniques- repair methods to reinforced concrete Columns, beams and slabs, Repair to steel structural members, Repair to masonry structures.

UNIT V  WORKING AT HEIGHTS

COURSE OUTCOMES
On completion of the course the student will be able to
CO1: Understand the effect of fire on materials used for construction
CO2: Understand the method of test for non-combustibility and fire resistance; and will be able to select different structural elements and their dimensions for a particular fire resistance rating of a building.
CO3: To understand the design concept of fire walls, fire screens, local barriers and fire doors and able to select them appropriately to prevent fire spread.
CO4: To decide the method of fire protection to RCC, steel, and wooden structural elements and their repair methods if damaged due to fire.
CO5: Describe the safety techniques and improve the analytical and intelligence to take the right
decision at right time.

TEXT BOOKS

REFERENCES:

CO's- PO's & PSO's MAPPING

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</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></td>
<td>2</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>
<tr>
<td>2</td>
<td></td>
<td>3</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>
<tr>
<td>3</td>
<td>1</td>
<td>2</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>
<tr>
<td>4</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>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2</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>
<tr>
<td>AVg.</td>
<td>1.3</td>
<td>1.75</td>
<td></td>
<td></td>
<td>1</td>
<td>1.3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OML351 INTRODUCTION TO NON-DESTRUCTIVE TESTING

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

- Understanding the basic importance of NDT in quality assurance.
- Imbibing the basic principles of various NDT techniques, its applications, limitations, codes and standards.
- Equipping themselves to locate a flaw in various materials, products.
- Applying the testing methods for inspecting materials in accordance with industry specifications and standards.
- Acquiring the knowledge on the selection of the suitable NDT technique for a given application

UNIT I INTRODUCTION TO NDT & VISUAL TESTING
Concepts of Non-destructive testing-relative merits and limitations-NDT Versus mechanical testing, Fundamentals of Visual Testing – vision, lighting, material attributes, environmental factors, visual perception, direct and indirect methods – mirrors, magnifiers, boroscopes and fibroscopes – light sources and special lighting.

UNIT II LIQUID PENETRANT & MAGNETIC PARTICLE TESTING
Liquid Penetrant Inspection: principle, applications, advantages and limitations, dyes, developers and cleaners, Methods & Interpretation.
Magnetic Particle Inspection: Principles, applications, magnetization methods, magnetic particles, Testing Procedure, demagnetization, advantages and limitations, – Interpretation and evaluation of test indications.

UNIT III  EDDY CURRENT TESTING & THERMOGRAPHY  9
Thermography- Principle, Contact & Non-Contact inspection methods, Active & Passive methods, Liquid Crystal – Concept, example, advantages & limitations. Electromagnetic spectrum, infrared thermography- approaches, IR detectors, Instrumentation and methods, applications.

UNIT IV  ULTRASONIC TESTING & AET  9

UNIT V  RADIOGRAPHY TESTING  9
Sources-X-rays and Gamma rays and their characteristics-absorption, scattering. Filters and screens, Imaging modalities-film radiography and digital radiography (Computed, Direct, Real Time, CT scan). Problems in shadow formation, exposure factors, inverse square law, exposure charts, Penetrameters, safety in radiography.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to
1. Realize the importance of NDT in various engineering fields.
2. Have a basic knowledge of surface NDE techniques which enables to carry out various inspection in accordance with the established procedures.
3. Calibrate the instrument and inspect for in-service damage in the components by means of Eddy current testing as well as Thermography testing.
4. Differentiate various techniques of UT and AET and select appropriate NDT methods for better evaluation.
5. Interpret the results of Radiography testing and also have the ability to analyse the influence of various parameters on the testing.

TEXT BOOKS:

REFERENCES:
### Course Objectives:
The main learning objective of this course is to prepare the students for:

1. Selecting sensors to develop mechatronics systems.
2. Explaining the architecture and timing diagram of microprocessor, and also interpret and develop programs.
3. Designing appropriate interfacing circuits to connect I/O devices with microprocessor.
4. Applying PLC as a controller in mechatronics system.
5. Designing and developing the appropriate mechatronics system for an application.

### Course Structure:

#### Unit I: Introduction and Sensors

- **Introduction to Mechatronics**
- Systems – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics.

#### Unit II: 8085 Microprocessor

- **Introduction**

#### Unit III: Programmable Peripheral Interface

- **Introduction**

#### Unit IV: Programmable Logic Controller

- **Introduction**
- Architecture – Input / Output Processing – Programming with Timers, Counters and Internal relays – Data Handling – Selection of PLC.

#### Unit V: Actuators and Mechatronics System Design


**Total: 45 Periods**
COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Select sensors to develop mechatronics systems.
CO2: Explain the architecture and timing diagram of microprocessor, and also interpret and develop programs.
CO3: Design appropriate interfacing circuits to connect I/O devices with microprocessor.
CO 4: Apply PLC as a controller in mechatronics system.
CO 5: Design and develop the apt mechatronics system for an application.

Mapping of COs with POs and PSOs

<table>
<thead>
<tr>
<th>COs/POs &amp; PSOs</th>
<th>POs 1</th>
<th>POs 2</th>
<th>POs 3</th>
<th>POs 4</th>
<th>POs 5</th>
<th>POs 6</th>
<th>POs 7</th>
<th>POs 8</th>
<th>POs 9</th>
<th>POs 10</th>
<th>POs 11</th>
<th>POs 12</th>
<th>PSOs 1</th>
<th>PSOs 2</th>
<th>PSOs 3</th>
<th>PSOs 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CO/PO &amp; PSO</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 – Slight, 2 – Moderate, 3 – Substantial</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TEXT BOOKS:

REFERENCES:

ORA351 FOUNDATION OF ROBOTICS

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

COURSE OBJECTIVES:
1. To study the kinematics, drive systems and programming of robots.
2. To study the basics of robot laws and transmission systems.
3. To familiarize students with the concepts and techniques of robot manipulator, its kinematics.
4. To familiarize students with the various Programming and Machine Vision application in robots.
5. To build confidence among students to evaluate, choose and incorporate robots in engineering systems.
UNIT – I  FUNDAMENTALS OF ROBOT  9

UNIT – II  ROBOT KINEMATICS  9
Forward kinematics, inverse kinematics and the difference: forward kinematics and inverse Kinematics of Manipulators with two, three degrees of freedom (in 2 dimensional), four degrees of freedom (in 3 dimensional) – derivations and problems. Homogeneous transformation matrices, translation and rotation matrices.

UNIT – III  ROBOT DRIVE SYSTEMS AND END EFFECTORS  9

UNIT – IV  SENSORS IN ROBOTICS  9
Force sensors, touch and tactile sensors, proximity sensors, non-contact sensors, safety considerations in robotic cell, proximity sensors, fail safe hazard sensor systems, and compliance mechanism. Machine vision system - camera, frame grabber, sensing and digitizing image data – signal conversion, image storage, lighting techniques, image processing and analysis – data reduction, segmentation, feature extraction, object recognition, other algorithms, applications – Inspection, identification, visual serving and navigation.

UNIT – V  PROGRAMMING AND APPLICATIONS OF ROBOT  9
Teach pendant programming, lead through programming, robot programming languages – VAL programming – Motion Commands, Sensors commands, End-Effector Commands, and simple programs - Role of robots in inspection, assembly, material handling, underwater, space and medical fields.

TOTAL : 45 PERIODS

COURSE OUTCOMES
At the end of the course, students will be able to:
CO1: Interpret the features of robots and technology involved in the control.
CO2: Apply the basic engineering knowledge and laws for the design of robotics.
CO3: Explain the basic concepts like various configurations, classification and parts of end effectors compare various end effectors and grippers and tools and sensors used in robots.
CO4: Explain the concept of kinematics, degeneracy, dexterity and trajectory planning.
CO5: Demonstrate the image processing and image analysis techniques by machine vision system.

<table>
<thead>
<tr>
<th>COs/POs&amp; PSOs</th>
<th>CO1</th>
<th>CO2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>11</td>
<td>11</td>
</tr>
<tr>
<td>11</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>12</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>13</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Mapping of COs with POs and PSOs

TOTAL 236
TEXT BOOKS:

REFERENCES:

OAE352 FUNDAMENTALS OF AERONAUTICAL ENGINEERING L T P C
3 0 0 3

OBJECTIVES:
- To acquire the knowledge on the Historical evaluation of Airplanes
- To learn the different component systems and functions
- To know the concepts of basic properties and principles behind the flight
- To learn the basics of different structures & construction
- To learn the various types of power plants used in aircrafts

UNIT I HISTORY OF FLIGHT 8
Balloon flight-ornithopter-Early Airplanes by Wright Brothers, biplanes and monoplanes, Developments in aerodynamics, materials, structures and propulsion over the years.

UNIT II AIRCRAFT CONFIGURATIONS AND ITS CONTROLS 10
Different types of flight vehicles, classifications-Components of an airplane and their functions-Conventional control, powered control- Basic instruments for flying-Typical systems for control actuation.

UNIT III BASICS OF AERODYNAMICS 9

UNIT IV BASICS OF AIRCRAFT STRUCTURES 9
General types of construction, Monocoque, semi-monocoque and geodesic constructions, typical wing and fuselage structure. Metallic and non-metallic materials. Use of Aluminium alloy, titanium,

UNIT V    BASICS OF PROPULSION  9
Basic ideas about piston, turboprop and jet engines – use of propeller and jets for thrust production-Comparative merits, Principle of operation of rocket, types of rocket and typical applications, Exploration into space.

TOTAL : 45 PERIODS

OUTCOMES:
• Illustrate the history of aircraft & developments over the years
• Ability to identify the types & classifications of components and control systems
• Explain the basic concepts of flight & Physical properties of Atmosphere
• Identify the types of fuselage and constructions.
• Distinguish the types of Engines and explain the principles of Rocket

TEXT BOOKS

REFERENCE
1. SADHU SINGH, “INTERNAL COMBUSTION ENGINES AND GAS TURBINE”-, SS Kataraia & sons, 2015

OGI351 REMOTE SENSING CONCEPTS L T P C
3 0 0 3

OBJECTIVES:
• To introduce the concepts of remote sensing processes and its components.
• To expose the various remote sensing platforms and sensors and to introduce the elements of data interpretation

UNIT I    REMOTE SENSING AND ELECTROMAGNETIC RADIATION  9

UNIT II   EMR INTERACTION WITH ATMOSPHERE AND EARTH MATERIAL  9
UNIT III  ORBITS AND PLATFORMS  
Motions of planets and satellites – Newton’s law of gravitation - Gravitational field and potential - Escape velocity - Kepler’s law of planetary motion - Orbit elements and types – Orbital perturbations and maneuvers – Types of remote sensing platforms - Ground based, Airborne platforms and Space borne platforms – Classification of satellites – Sun synchronous and Geosynchronous satellites – Lagrange Orbit.

UNIT IV  SENSING TECHNIQUES  

UNIT V  DATA PRODUCTS AND INTERPRETATION  
Photographic and digital products – Types, levels and open source satellite data products -- selection and procurement of data– Visual interpretation: basic elements and interpretation keys - Digital interpretation – Concepts of Image rectification, Image enhancement and Image classification

TOTAL:45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to:

**CO 1** Understand the concepts and laws related to remote sensing

**CO 2** Understand the interaction of electromagnetic radiation with atmosphere and earth material

**CO 3** Acquire knowledge about satellite orbits and different types of satellites

**CO 4** Understand the different types of remote sensors

**CO 5** Gain knowledge about the concepts of interpretation of satellite imagery

TEXTBOOKS:

REFERENCES:

CO-PO MAPPING

<table>
<thead>
<tr>
<th>PO</th>
<th>Graduate Attribute</th>
<th>Course Outcome</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>CO1  CO2  CO3  CO4  CO5</td>
<td></td>
</tr>
<tr>
<td>PO1</td>
<td>Engineering Knowledge</td>
<td>3    3    3    3    3</td>
<td>3</td>
</tr>
<tr>
<td>PO2</td>
<td>Problem Analysis</td>
<td>3    3    3</td>
<td></td>
</tr>
<tr>
<td>PO3</td>
<td>Design/Development of Solutions</td>
<td>3    3    3</td>
<td></td>
</tr>
<tr>
<td>PO4</td>
<td>Conduct Investigations of Complex Problems</td>
<td>3    3    3</td>
<td>3</td>
</tr>
</tbody>
</table>
OBJECTIVES:
- To introduce the students the principles of agricultural crop production and the production practices of crops in modern ways.
- To delineate the role of agricultural engineers in relation to various crop production practices.

UNIT I INTRODUCTION
Benefits of urban agriculture- economic benefits, environmental benefits, social and cultural benefits, educational, skill-building and job training benefits, health, nutrition and food accessibility benefits.

UNIT II VERTICAL FARMING

UNIT III SOIL LESS CULTIVATION
Hydroponics, aeroponics, aquaponics: merits and limitations, costs and Challenges, backyard gardens- tactical gardens- street landscaping- forest gardening, greenhouses, urban beekeeping

UNIT IV MODERN CONCEPTS
Growth of plants in vertical pipes in terraces and inside buildings, micro irrigation concepts suitable for roof top gardening, rain hose system, Green house, polyhouse and shade net system of crop production on roof tops

UNIT V WASTE MANAGEMENT
Concept, scope and maintenance of waste management- recycle of organic waste, garden wastes-solid waste management-scope, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues, waste utilization.

TOTAL: 45 PERIODS
1. Demonstrate the principles behind crop production and various parameters that influences the crop growth on roof tops
2. Explain different methods of crop production on roof tops
3. Explain nutrient and pest management for crop production on roof tops
4. Illustrate crop water requirement and irrigation water management on roof tops
5. Explain the concept of waste management on roof tops

TEXT BOOKS:

REFERENCES:

CO-PO MAPPING

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
<th>Overall correlation of COs with POs</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1 Engineering Knowledge</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>PO2 Problem Analysis</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>PO3 Design/ Development of Solutions</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>PO4 Conduct Investigations of Complex Problems</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO5 Modern Tool Usage</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>PO6 The Engineer and Society</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO7 Environment and sustainability</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>PO8 Ethics</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>PO9 Individual and team work:</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO10 Communication</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>PO11 Project management and finance</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>PO12 Life-long learning:</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>PSO1 To make expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>PSO2 To enhance students ability to formulate solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies.</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
OEN351 DRINKING WATER SUPPLY AND TREATMENT  

OBJECTIVE:  
- To equip the students with the principles and design of water treatment units and distribution system.

UNIT I SOURCES OF WATER  

UNIT II CONVEYANCE FROM THE SOURCE  

UNIT III WATER TREATMENT  
Objectives – Unit operations and processes – Principles, functions, and design of water treatment plant units, aerators of flash mixers, Coagulation and flocculation — sand filters - Disinfection — Construction, Operation and Maintenance aspects.

UNIT IV ADVANCED WATER TREATMENT  

UNIT V WATER DISTRIBUTION AND SUPPLY  

TOTAL: 45 PERIODS

OUTCOMES  
CO1: An understanding of water quality criteria and standards, and their relation to public health  
CO2: The ability to design the water conveyance system  
CO3: The knowledge in various unit operations and processes in water treatment  
CO4: An ability to understand the various systems for advanced water treatment  
CO5: An insight into the structure of drinking water distribution system

TEXT BOOKS:  

REFERENCES:

CO’s- PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</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></td>
<td>3</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>
<tr>
<td>2</td>
<td></td>
<td>3</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>
<tr>
<td>3</td>
<td></td>
<td>3</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>
<tr>
<td>4</td>
<td></td>
<td>3</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>
<tr>
<td>5</td>
<td></td>
<td>3</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>
<tr>
<td>Avg.</td>
<td></td>
<td>3</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>

1.low, 2-medium, 3-high, ‘-‘- no correlation
Note: The average value of this course to be used for program articulation matrix.

OEE352 ELECTRIC VEHICLE TECHNOLOGY L T P C

COURSE OBJECTIVES
- To provide knowledge about electric machines and special machine
- To understand the basics of power converters
- To know the concepts of controlling DC and AC drive systems
- To understand the architecture and power train components.
- To impart knowledge on vehicle control for standard drive cycles of hybrid electrical vehicles (HEVs)

UNIT I ROTATING POWER CONVERTERS

UNIT II STATIC POWER CONVERTERS
Working and Characteristics of Power Diodes, MOSFET and IGBT. Working of uncontrolled rectifiers, controlled rectifiers (Single phase and Three phase), DC choppers, single and three phase inverters, Multilevel inverters and Matrix Converters.

UNIT III CONTROL OF DC AND AC MOTOR DRIVES
Speed control for constant torque, constant HP operation of all electric motors - DC/DC chopper based four quadrant operation of DC motor drives, inverter based V/f Operation (motoring and braking) of induction motor drives, Transformation theory, vector control operation of Induction motor and PMSM, Brushless DC motor drives, Switched reluctance motor (SRM) drives
UNIT IV HYBRID ELECTRIC VEHICLE ARCHITECTURE AND POWER TRAIN COMPONENTS


UNIT V MECHANICS OF HYBRID ELECTRIC VEHICLES AND CONTROL OF VEHICLES

Fundamentals of vehicle mechanics - tractive force, power and energy requirements for standard drive cycles of HEV’s - motor torque and power rating and battery capacity. HEV supervisory control - Selection of modes - power spilt mode - parallel mode - engine brake mode - regeneration mode - series parallel mode

COURSE OUTCOMES:
CO1: Able to understand the principles of conventional and special electrical machines.
CO2: Acquired the concepts of power devices and power converters
CO3: Able to understand the control for DC and AC drive systems.
CO4: Learned the electric vehicle architecture and power train components.
CO5: Acquired the knowledge of mechanics of electric vehicles and control of electric vehicles.

<table>
<thead>
<tr>
<th></th>
<th>P</th>
<th>P</th>
<th>P</th>
<th>P</th>
<th>P</th>
<th>P</th>
<th>P</th>
<th>P</th>
<th>P</th>
<th>P</th>
<th>P</th>
<th>P</th>
<th>P</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</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>
<tr>
<td>CO2</td>
<td>3</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>
<tr>
<td>CO3</td>
<td>3</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>
<tr>
<td>CO4</td>
<td>3</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>
<tr>
<td>CO5</td>
<td>3</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>
<tr>
<td>Avg</td>
<td>3</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>

TOTAL: 45 PERIODS

REFERENCES:

OEI353 INTRODUCTION TO PLC PROGRAMMING

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

COURSE OBJECTIVES:
1. Understand basic PLC terminologies digital principles, PLC architecture and operation.
2. Familiarize different programming language of PLC.
3. Develop PLC logic for simple applications using ladder logic.
4. Understand the hardware and software behind PLC and SCADA.
5. Exposures about communication architecture of PLC/SCADA.

UNIT I  INTRODUCTION TO PLC
Introduction to PLC: Microprocessor, I/O Ports, Isolation, Filters, Drivers, Microcontrollers/DSP, PLC/DDC- PLC Construction: What is a PLC, PLC Memories, PLC I/O, PLC Special I/O, PLC Types.

UNIT II  PLC INSTRUCTIONS
PLC Basic Instructions: PLC Ladder Language- Function block Programming- Ladder/Function Block functions- PLC Basic Instructions, Basic Examples (Start Stop Rung, Entry/Reset Rung)- Configuration of Sensors, Switches, Solid State Relays- Interlock examples- Timers, Counters, Examples.

UNIT III  PLC PROGRAMMING
Different types of PLC program, Basic Ladder logic, logic functions, PLC module addressing, registers basics, basic relay instructions, Latching Relays, arithmetic functions, comparison functions, data handling, data move functions, timer-counter instructions, input-output instructions, sequencer instructions.

UNIT IV  COMMUNICATION OF PLC AND SCADA
Communication Protocol – Modbus, HART, Profibus- Communication facilities SCADA: - Hardware and software, Remote terminal units, Master Station and Communication architectures.

UNIT V  CASE STUDIES
Stepper Motor Control- Elevator Control- CNC Machine Control- conveyor control- Interlocking Problems

TOTAL: 45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1. Market survey of the recent PLCs and comparison of their features.
2. Summarize the PLC standards
3. Familiarization of any one programming language (Ladder diagram/ Sequential Function Chart/ Function Block Diagram/ Equivalent open source software)
4. Market survey of Communication Network Used for PLC/SCADA.

COURSE OUTCOMES:
CO1 Know the basic requirement of a PLC input/output devices and architecture. (L1)
CO2 Ability to apply Basics Instruction Sets used for ladder Logic and Function Block Programming. (L2)
CO3 Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block. (L3)
CO4 Able to develop a PLC logic for a specific application on real world problem. (L5)
CO5 Ability to Understand the Concepts of Communication used for PLC/SCADA. (L1)

TEXT BOOKS:
1. Frank Petruzzula, Programmable Logic Controllers, Tata Mc-Graw Hill Edition
2. John W. Webb, Ronald A. Reis, Programmable Logic Controllers Principles and Applications, PHI publication
REFERENCES:
2. J. R. Hackworth and F. D. Hackworth, Programmable Logic Controllers Principles and Applications, Pearson publication

List of Open Source Software/ Learning website:
1. https://nptel.ac.in/courses/108105063
3. https://www.etf.ues.rs.ba/~slubur/Procesni%20racunari/Programmable%20Logic%20Contr
ollers%20Programming%20Methods.pdf

MAPPING COURSE OUTCOMES WITH PROGRAMME OUTCOMES

<table>
<thead>
<tr>
<th></th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCH351</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

UNIT I INTRODUCTION
General definition and size effects–important nano structured materials and nano particles—importance of nano materials- Size effect on thermal, electrical, electronic, mechanical, optical and magnetic properties of nanomaterials- surface area - band gap energy and applications. Photochemistry and Electrochemistry of nanomaterials – Ionic properties of nanomaterials- Nano catalysis.

UNIT II SYNTHESIS OF NANOMATERIALS
Bottom up and Top-down approach for obtaining nano materials - Precipitation methods – sol gel technique – high energy ball milling, CVD and PVD methods, gas phase condensation, magnetron sputtering and laser deposition methods – laser ablation, sputtering.

UNIT III NANO COMPOSITES
Definition- importance of nanocomposites- nano composite materials-classification of composites-metal/metal oxides, metal-polymer- thermoplastic based, thermoset based and elastomer based-influence of size, shape and role of interface in composites applications.

UNIT IV NANO STRUCTURES AND CHARACTERIZATION TECHNIQUES
Classifications of nanomaterials - Zero dimensional, one-dimensional and two-dimensional nanostructures- Kinetics in nanostructured materials- multilayer thin films and superlattice-
clusters of metals, semiconductors and nanocomposites. Spectroscopic techniques, Diffraction methods, thermal analysis method, BET analysis method.

UNIT V APPLICATIONS OF NANO MATERIALS

Overview of nanomaterials properties and their applications, nano painting, nano coating, nanomaterials for renewable energy, Molecular Electronics and Nanoelectronics – Nanobots-Biological Applications. Emerging technologies for environmental applications- Practice of nanoparticles for environmental remediation and water treatment.

TOTAL : 45 PERIODS

OUTCOMES:
CO1 Understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications.
CO2 Able to acquire knowledge about the different types of nano material synthesis
CO3 Describes about the shape, size, structure of composite nano materials and their interference
CO4 Understand the different characterization techniques for nanomaterials
CO5 Develop a deeper knowledge in the application of nanomaterials in different fields.

TEXT BOOKS

REFERENCES

COURSE ARTICULATION MATRIX

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Statement</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>understand the basic properties such as structural, physical, chemical properties of nanomaterials and their applications</td>
<td>T F T T F T T F T</td>
</tr>
<tr>
<td>OCH352</td>
<td>FUNCTIONAL MATERIALS</td>
<td>L</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>----------------------</td>
<td>---</td>
</tr>
<tr>
<td><strong>OBJECTIVE:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• The course emphasis on the molecular safe assembly and materials for polymer electronics</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>UNIT I</strong> INTRODUCTION</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td><strong>UNIT II</strong> MOLECULAR SELF ASSEMBLY</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td><strong>UNIT III</strong> BIO-INSPIRED MATERIALS</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td><strong>UNIT IV</strong> SMART OR INTELLIGENT MATERIALS</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Criteria for Smartness, Significance of Smart Materials, Representative Examples like Smart Gels and Polymers, Electro/Magneto Rheological Fluids, Smart Electroceramics, Technical Limitations and Challenges, Functional Nanocomposites, Polymer-carbon nanotube composites.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>UNIT V</strong> MATERIALS FOR POLYMER ELECTRONICS</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>Polymers for Electronics, Organic Light Emitting Diodes, Working Principle of OLEDs, Illustrated Examples, Organic Field-Effect Transistors Operating Principle, Design Considerations, Polymer FETs vs Inorganic FETs, Liquid Crystal Displays, Engineering Aspects of Flat Panel Displays, Intelligent Polymers for Data Storage, Polymer-based Data Storage-Principle, Magnetic Vs. Polymer-based Data Storage.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL: 45 PERIODS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**OUTCOME:**

• Students will be able to differentiate among various functional properties and select appropriate material for certain functional applications, analyze the nature and potential of functional material.

**TEXT BOOK:**
OBJECTIVE:
- To help students acquire a sound knowledge on diversities of foods, food habits and patterns in India with focus on traditional foods.

UNIT I  HISTORICAL AND CULTURAL PERSPECTIVES
Food production and accessibility - subsistence foraging, horticulture, agriculture and pastoralization, origin of agriculture, earliest crops grown. Food as source of physical sustenance, food as religious and cultural symbols; importance of food in understanding human culture - variability, diversity, from basic ingredients to food preparation; impact of customs and traditions on food habits, heterogeneity within cultures (social groups) and specific social contexts - festive occasions, specific religious festivals, mourning etc. Kosher, Halal foods; foods for religious and other fasts.

UNIT II TRADITIONAL METHODS OF FOOD PROCESSING

UNIT III TRADITIONAL FOOD PATTERNS
Typical breakfast, meal and snack foods of different regions of India. Regional foods that have gone Pan Indian / Global. Popular regional foods; Traditional fermented foods, pickles and preserves, beverages, snacks, desserts and sweets, street foods; IPR issues in traditional foods

UNIT IV COMMERCIAL PRODUCTION OF TRADITIONAL FOODS
Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods – types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi. Commercial production of intermediate foods – ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters.

UNIT V HEALTH ASPECTS OF TRADITIONAL FOODS
Comparison of traditional foods with typical fast foods / junk foods – cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments /illnesses.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1 To understand the historical and traditional perspective of foods and food habits
CO2 To understand the wide diversity and common features of traditional Indian foods and meal patterns.

TEXT BOOKS:
OFD353 INTRODUCTION TO FOOD PROCESSING

OBJECTIVE:
• The course aims to introduce the students to the area of Food Processing. This is necessary for effective understanding of a detailed study of food processing and technology subjects. This course will enable students to appreciate the importance of food processing with respect to the producer, manufacturer and consumer.

UNIT I PROCESSING OF FOOD AND ITS IMPORTANCE
Source of food - plant, animal and microbial origin; different foods and groups of foods as raw materials for processing – cereals, pulses, grains, vegetables and fruits, milk and animal foods, sea weeds, algae, oil seeds & fats, sugars, tea, coffee, cocoa, spices and condiments, additives; need and significance of processing these foods.

UNIT II METHODS OF FOOD HANDLING AND STORAGE
Nature of harvested crop, plant and animal; storage of raw materials and products using low temperature, refrigerated gas storage of foods, gas packed refrigerated foods, sub atmospheric storage, Gas atmospheric storage of meat, grains, seeds and flour, roots and tubers; freezing of raw and processed foods.

UNIT III LARGE-SCALE FOOD PROCESSING
Milling of grains and pulses; edible oil extraction; Pasteurisation of milk and yoghurt; canning and bottling of foods; drying – Traditional and modern methods of drying, Dehydration of fruits, vegetables, milk, animal products etc; preservation by use of acid, sugar and salt; Pickling and curing with microorganisms, use of salt, and microbial fermentation; frying, baking, extrusion cooking, snack foods.

UNIT IV FOOD WASTES IN VARIOUS PROCESSES
Waste disposal-solid and liquid waste; rodent and insect control; use of pesticides; ETP; selecting and installing necessary equipment.

UNIT V FOOD HYGIENE
Food related hazards – Biological hazards – physical hazards – microbiological considerations in foods. Food adulteration – definition, common food adulterants, contamination with toxic metals, pesticides and insecticides; Safety in food procurement, storage handling and preparation; Relationship of microbes to sanitation, Public health hazards due to contaminated water and food; Personnel hygiene; Training& Education for safe methods of handling and processing food; sterilization and disinfection of manufacturing plant; use of sanitizers, detergents, heat, chemicals, Cleaning of equipment and premises.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course the students are expected to
CO1 Be aware of the different methods applied to processing foods.
CO2 Be able to understand the significance of food processing and the role of food and beverage industries in the supply of foods.

TEXT BOOKS/REFERENCES:
OPY352  IPR FOR PHARMA INDUSTRY  L T P C
3 0 0 3

COURSE OBJECTIVES:
- To provide the basic fundamental knowledge of different forms of Intellectual Property Rights in national and international level.
- To provide the significance of the Intellectual Property Rights about the patents, copyrights, industrial design, plant and geographical indications.
- This paper is to study significance of the amended patent act on pharma industry.

UNIT I  INTRODUCTION- INTELLECTUAL PROPERTY RIGHTS 9
Introduction, Types of Intellectual Property Rights - patents, plant varieties protection, geographical indicators, copyright, trademark, trade secrets.

UNIT II  PATENTS 9
Patents-Objective, Introduction, Requirement for patenting- Novelty, Inventive step (Non-obviousness) and industrial application (utility), Non-patentable inventions, rights of patent owner, assignment of patent rights, patent specification (provisional and complete), parts of complete specification, claims, procedure for obtaining patents, compulsory license.

UNIT III  PLANT VARIETY-TRADITIONAL KNOWLEDGE–GEOGRAPHICAL INDICATIONS 9
Plant variety- Justification, criteria for protection of plant variety and protection in India. Traditional knowledge- Concept of traditional knowledge, protection of traditional knowledge under Intellectual Property frame works in national level and Traditional knowledge digital library (TKDL). Geographical Indications – Justification for protection, National and International position.

UNIT IV  ENFORCEMENT AND PRACTICAL ASPECTS OF IPR 9

UNIT V  INTERNATIONAL BACKGROUND OF INTELLECTUAL PROPERTY 9

TOTAL: 45 PERIODS

TEXT BOOKS:
REFERENCES:
2. Basic Principles of patent law – Basics principles and acquisition of IPR. Ramakrishna T. CIPRA, NLSIU, Bangalore, 2005

COURSE OUTCOME
The student will be able to
C1 Understand and differentiate the categories of intellectual property rights.
C2 Describe about patents and procedure for obtaining patents.
C3 Distinguish plant variety, traditional knowledge and geographical indications under IPR.
C4 Provide the information about the different enforcements and practical aspects involved in protection of IPR.
C5 Provide different organizations role and responsibilities in the protection of IPR in the international level.
C6 Understand the interrelationships between different Intellectual Property Rights on International Society

<table>
<thead>
<tr>
<th>CO – PO MAPPING</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>C1</td>
</tr>
<tr>
<td>C2</td>
</tr>
<tr>
<td>C3</td>
</tr>
<tr>
<td>C4</td>
</tr>
<tr>
<td>C5</td>
</tr>
<tr>
<td>C6</td>
</tr>
</tbody>
</table>

OTT351 BASICAS OF TEXTILE FINISHING
L T P C 3 0 0 3

OBJECTIVE:
- To enable the students to understand the basics and different types of finishes required for textile materials and machines used for finishing.

UNIT I RESIN FINISHING

UNIT II FLAME PROOF & WATERPROOF
Concept of Flame proof & flame retardancy. Flame retardant finishes for cotton. Concept of waterproof and water repellent Finishes, Durable & Semi durable and Temporary finishes, Concept of Antimicrobial finish.

UNIT III SOIL RELEASE AND ANTISTATIC FINISHES

252

UNIT IV MECHANICAL FINISHES

UNIT V STIFFENING AND SOFTENING
Concept of stiffening and softening of textile materials. Mechanism in the weight reduction of PET. Concept of Micro encapsulation techniques in finishing process, Nano finish, Plasma Treatment and Bio finishing.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to Understand the
 CO: 2 Concept of Flame proof & flame retardancy, waterproof and water repellent, Antimicrobial finishes.
 CO: 3 Concept of Soil Release, Anti Pilling, UV Protection and Antistatic finishes.
 CO: 4 Concept of Mechanical finishing.
 CO: 5 Basics of Micro encapsulation techniques, Nano finish, Plasma Treatment.

TEXT BOOKS:

REFERENCES:
1. Microencapsulation in finishing, Review of progress of Colouration, SDC, 2001 62

OTT352 INDUSTRIAL ENGINEERING FOR GARMENT INDUSTRY L T P C
3 0 0 3

OBJECTIVES:
• To enable the students to learn about basics of industrial engineering and different tools of industrial engineering and its application in apparel industry

UNIT I INTRODUCTION
Scope of industrial engineering in apparel Industry, role of industrial engineers. Productivity: Definition - Productivity, Productivity measures. Reduction of work content due to the product and process, Reduction of ineffective time due to the management, due to the worker. Causes for low productivity in apparel industry and measures for improvement.

UNIT II WORK STUDY
Definition, Purpose, Basic procedure and techniques of work-study. Work environment – Lighting, Ventilation, Climatic condition on productivity. Temperature control, humidity control, noise control measures. Safety and ergonomics on work station and work environment Material Handling – Objectives, Classification and characteristics of material handling
equipments, Specialized material handling equipments.

UNIT III  METHOD STUDY
Definition, Objectives, Procedure, Process charts and symbols. Various charts – Charts indicating process sequence: Outline process chart, flow process chart (man type, material type and equipment type); Charts using time scale – multiple activity chart. Diagrams indicating movement – flow diagram, string diagram, cycle graph, chrono cycle graph, travel chart
MOTION STUDY:  Principle of motion economy, Two handed process chart, micro motion analysis – therbligs, SIMO chart.

UNIT IV  WORK MEASUREMENT
Definition, purpose, procedure, equipments, techniques. Time study - Definition, basics of time study- equipments. Time study forms, Stop watch procedure. Predetermined motion time standards (PMTS). Time Study rating, calculation of standard time, Performance rating – relaxation and other allowances. Calculation of SAM for different garments, GSD.

UNIT V  WORK STUDY APPLICATION
Application of work study techniques in cutting, stitching and packing in garment industry. Workaids in sewing, Pitch diagram, Line balancing, Capacity planning, scientific method of training.

OUTCOMES:
Upon the completion of the course the student shall be able to understand
CO1: Fundamental concepts of industrial Engineering and productivity
CO2: Method study
CO3: Motion analysis
CO4: Work measurement and SAM
CO5: Ergonomics and its application to garment industry

TEXT BOOKS:

REFERENCES

Course Articulation Matrix:

<table>
<thead>
<tr>
<th>Course Outcome</th>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>Fundamental concepts of Industrial Engineering and productivity</td>
</tr>
<tr>
<td>CO2</td>
<td>Method study</td>
</tr>
<tr>
<td>CO3</td>
<td>Motion analysis</td>
</tr>
</tbody>
</table>

TOTAL: 45 PERIODS
1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

OTT353 BASICS OF TEXTILE MANUFACTURE L T P C 3 0 0 3

OBJECTIVES:
To enable the students to learn about the basics of fibre forming, yarn production, fabric formation, coloration of fabrics and garment manufacturing

UNIT I NATURAL FIBRES 9
Introduction: Definition of staple fibre, filament; Classification of natural and man-made fibres, essential and desirable properties of fibres. Production and cultivation of Natural Fibers: Cultivation of cotton, production of silk (sericulture), wool and jute – physical and chemical structure of these fibres..

UNIT II REGENERATED AND SYNTHETIC FIBRES 9
Production sequence of regenerated and modified cellulosic fibres: viscose rayon, Acetate Rayon, high wet modulus and high tenacity fibres; synthetic fibres – chemical structure, fibre forming polymers, production principles.

UNIT III BASICS OF SPINNING 9
Spinning – principle of yarn formation, sequence of machines for yarn production with short staple fibres and blends, principles of opening and cleaning machines; yarn numbering - calculations

UNIT IV BASICS OF WEAVING 9
Woven fabric – warp, weft, weaving, path of warp; looms – classification, handloom and its parts, powerloom, automatic looms, shuttleless looms, special type of looms; preparatory machines for weaving process and their objectives; basic weaving mechanism - primary, secondary and auxiliary mechanisms,

UNIT V BASICS OF KNITTING AND NONWOVEN 9

TOTAL : 45 PERIODS

OUTCOMES:
On completion of this course, the students shall have the basic knowledge on
CO1: Classification of fibres and production of natural fibres
CO2: Regenerated and synthetic fibres
CO3: Yarn spinning
CO4: Weaving
CO5: Knitting and nonwoven

TEXTBOOKS

REFERENCES:
### COURSE OUTCOMES STATEMENT PROGRAM OUTCOME

<table>
<thead>
<tr>
<th>COURSE STATEMENTS</th>
<th>PROGRAM OUTCOMES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regenerated and synthetic fibres</td>
<td>- - - - - - 2 1 - 1 1 - 1 -</td>
</tr>
<tr>
<td>Yarn spinning</td>
<td>- - - - - - 2 1 - 1 1 - 1 -</td>
</tr>
<tr>
<td>Weaving</td>
<td>- - - - - - 2 1 - 1 1 - 1 -</td>
</tr>
<tr>
<td>Knitting and nonwoven</td>
<td>- - - - - - 2 1 - 1 1 - 1 -</td>
</tr>
<tr>
<td>Overall CO</td>
<td>- - - - - - 2 1 - 1 1 - 1 -</td>
</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

### OPE351 INTRODUCTION TO PETROLEUM REFINING AND PETROCHEMICALS

**OBJECTIVE:**
The course is aimed to
Gain knowledge about petroleum refining process and production of petrochemical products.

**UNIT I** ORIGIN, FORMATION AND REFINING OF CRUDE OIL 9

**UNIT II** CRACKING 9
Cracking, Thermal Cracking, Vis-breaking, Catalytic Cracking (FCC), Hydro Cracking, Coking and Air Blowing of Bitumen

**UNIT III** REFORMING AND HYDROTREATING 9

**UNIT IV** INTRODUCTION TO PETROCHEMICALS 9
UNIT V PRODUCTION OF PETROCHEMICALS
Production of Petrochemicals like Dimethyl Terephthalate (DMT), Ethylene Glycol, Synthetic glycerine, Linear Alkyl Benzene (LAB), Acrylonitrile, Methyl Methacrylate (MMA), Vinyl Acetate Monomer, Phthalic Anhydride, Maleic Anhydride, Phenol, Acetone, Methanol, Formaldehyde, Acetaldehyde, Pentaerythritol and production of Carbon Black.

TOTAL: 45 PERIODS

OUTCOMES:
On the completion of the course students are expected to
CO1: Understand the classification, composition and testing methods of crude petroleum and its products. Learn the mechanism of refining process.
CO2: Understand the insights of primary treatment processes to produce the precursors.
CO3: Study the secondary treatment processes cracking, vis-breaking and coking to produce more petroleum products.
CO4: Appreciate the need of treatment techniques for the removal of sulphur and other impurities from petroleum products.
CO5: Understand the societal impact of petrochemicals and learn their manufacturing processes.
CO6: Learn the importance of optimization of process parameters for the high yield of petroleum products.

TEXT BOOKS:

REFERENCES:

CPE334 ENERGY CONSERVATION AND MANAGEMENT 9

OBJECTIVES:
At the end of the course, the student is expected to
- understand and analyse the energy data of industries
- carryout energy accounting and balancing
- conduct energy audit and suggest methodologies for energy savings and
- utilise the available resources in optimal ways

UNIT I INTRODUCTION

UNIT II ELECTRICAL SYSTEMS
Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors,

UNIT III THERMAL SYSTEMS

UNIT IV ENERGY CONSERVATION IN MAJOR UTILITIES
Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

UNIT V ECONOMICS
Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of this course, the students can able to analyze the energy data of industries.
CO1: Remember the knowledge for Basic combustion and furnace design and selection of thermal and mechanical energy equipment.
CO2: Study the Importance of Stoichiometry relations, Theoretical air required for complete combustion.
CO3: Skills on combustion thermodynamics and kinetics.
CO4: Apply calculation and design tube still heaters.
CO5: Studied different heat treatment furnace.
CO6: Practical and theoretical knowledge burner design.

TEXT BOOKS:

REFERENCES:

OPT351 BASICS OF PLASTICS PROCESSING L T P C
3 0 0 3

COURSE OBJECTIVES
- Understand the fundamentals of plastics processing, such as the relationships between material structural properties and required processing parameters, and so on
- To gain practical knowledge on the polymer selection and its processing
- Understanding the major plastic material processing techniques (Extrusion, Injection molding, Compression and Transfer molding, Blow molding, Thermoforming and casting)
UNIT I INTRODUCTION TO PLASTICS PROCESSING


UNIT II EXTRUSION


UNIT III INJECTION MOLDING

Injection molding – Principles and processing outline, machinery, accessories and functions, specifications, process variables, mould cycle. Types of clamping: hydraulic and toggle mechanisms. Start-up and shut down procedures-Cylinder nozzles- Press capacity projected area -Shot weight Basic theoretical concepts and their relationship to processing - Interaction of moulding process aspect effects in quoted variables. Basic mould types. Reciprocating vs. plunger type injection moulding. Thermoplastic vs. thermosetting injection moulding. Injection moulding vs. other plastic processing techniques. State-of-the-art injection moulding techniques - Introduction to trouble shooting

UNIT IV COMPRESSION AND TRANSFER MOLDING

Compression moulding – Basic principles of compression and transfer moulding-Meaning of terms- Bulk factor and flow properties, moulding materials, process variables and process cycle, Inter relation between flow properties-Curing time-Mould temperature and Pressure requirements. Preforms and preheating- Techniques of preheating. Machines used-Types of compression mould-positive, semi-positive and flash. Common moulding faults and their correction- Finishing of mouldings. Transfer moulding: working principle, equipment, Press capacity-Integral moulds and auxiliary ram moulds, moulding cycle, moulding tolerances, pot transfer, plunger transfer and screw transfer moulding techniques, advantages over compression moulding

UNIT V BLOW MOLDING, THERMOFORMING AND CASTING


TOTAL: 45 PERIODS

COURSE OUTCOMES

- Ability to find out the correlation between various processing techniques with product properties.
- Understand the major plastics processing techniques used in moulding (injection, blow, compression, and transfer), extrusion, thermoforming, and casting.
- Acquire knowledge on additives for plastic compounding and methods employed for the same
- Familiarize with the machinery and ancillary equipment associated with various plastic processing techniques.
- Select an appropriate processing technique for the production of a plastic product
REFERENCES:

OEC351 SIGNALS AND SYSTEMS  L T P C  3 0 0 3

COURSE OBJECTIVES:
● To understand the basic properties of signal & systems
● To know the methods of characterization of LTI systems in time domain
● To analyze continuous time signals and system in the Fourier and Laplace domain
● To analyze discrete time signals and system in the Fourier and Z transform domain

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS  9
Standard signals- Step, Ramp, Pulse, Impulse, Real and complex exponentials and Sinusoids Classification of signals – Continuous time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems- – Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS  9
Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and Properties

UNIT III LINEAR TIME INVARIANT CONTINUOUS TIME SYSTEMS  9

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS  9
Baseband signal Sampling–Fourier Transform of discrete time signals (DTFT)– Properties of DTFT - Z Transform & Properties

UNIT V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS  9

TOTAL: 45 PERIODS
COURSE OUTCOMES:
At the end of the course, the student will be able to:
CO1: Determine if a given system is linear/causal/stable
CO2: Determine the frequency components present in a deterministic signal
CO3: Characterize continuous LTI systems in the time domain and frequency domain
CO4: Characterize discrete LTI systems in the time domain and frequency domain
CO5: Compute the output of an LTI system in the time and frequency domains

TEXT BOOKS:

REFERENCES:
UNIT III  MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER  9
Cascode amplifier, Differential amplifier – Common mode and Difference mode analysis – Tuned amplifiers – Gain and frequency response – Neutralization methods.

UNIT IV  FEEDBACK AMPLIFIERS AND OSCILLATORS  9

UNIT V  POWER AMPLIFIERS AND DC/DC CONVERTERS  9
Power amplifiers- class A-Class B-Class AB-Class C-Temperature Effect- Class AB Power amplifier using MOSFET –DC/DC convertors – Buck, Boost, Buck-Boost analysis and design.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course the students will be able to
CO1: Explain the structure and working operation of basic electronic devices.
CO2: Design and analyze amplifiers.
CO3: Analyze frequency response of BJT and MOSFET amplifiers
CO4: Design and analyze feedback amplifiers and oscillator principles.
CO5: Design and analyze power amplifiers and supply circuits

TEXT BOOKS:

REFERENCES:
OBJECTIVES:
• To understand the global trends and development methodologies of various types of products and services
• To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems
• To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them into design specification
• To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics
• To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer

UNIT I    BASICS OF PRODUCT DEVELOPMENT

UNIT II    REQUIREMENTS AND SYSTEM DESIGN

UNIT III    DESIGN AND TESTING

UNIT IV    SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT

UNIT V    BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to:
• Define, formulate, and analyze a problem
• Solve specific problems independently or as part of a team
- Gain knowledge of the Innovation & Product Development process in the Business Context
- Work independently as well as in teams
- Manage a project from start to finish

**TEXT BOOKS:**
1. Book specially prepared by NASSCOM as per the MoU.

**REFERENCES:**

**CO’s- PO’s & PSO’s MAPPING**

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

**AVg.**

**OBM333 ASSISTIVE TECHNOLOGY**

**OBJECTIVES:**
The student should be made to:
- To know the hardware requirement various assistive devices
- To understand the prosthetic and orthotic devices
- To know the developments in assistive technology

**UNIT I CARDIAC ASSIST DEVICES**
Cardiac functions and parameters, principle of External counter pulsation techniques, intra aortic balloon pump, Auxillary ventricle and schematic for temporary bypass of left ventricle, prosthetic heart valves, cardiac pacemaker.

**UNIT II HEMODIALYSISERS**
Physiology of kidney, Artificial kidney, Dialysis action, hemodialyser unit, membrane dialysis, portable dialyser monitoring and functional parameters.

**UNIT III HEARING AIDS**
Anatomy of ear, Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids.
UNIT IV PROSTHETIC AND ORTHODIC DEVICES
Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthotic system, functional electrical stimulation, sensory assist devices.

UNIT V RECENT TRENDS
Transcutaneous electrical nerve stimulator, bio-feedback, assistive devices in drug delivery

TOTAL: 45 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
CO1: Interpret the various mechanical techniques that will help in assisting the heart functions.
CO2: Describe the underlying principles of hemodialyzer machine.
CO3: Indicate the methodologies to assess the hearing loss.
CO4: Evaluate the types of assistive devices for mobilization.
CO5: Explain about TENS and biofeedback system.

TEXT BOOKS:

REFERENCES:
4. Cardiac Assist Devices, Daniel Goldstein (Editor), Mehmet Oz (Editor), Wiley-Blackwell April 2000 ISBN: 978-0-879-93449-1

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>1 1 1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>1 1 1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>1 1 1</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>1 1 1</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>1 1 1</td>
</tr>
<tr>
<td>Avg.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
OBJECTIVES:
This course will help the students to
- Determine the optimum solution for Linear programming problems.
- Study the Transportation and assignment models and various techniques to solve them.
- Acquire the knowledge of optimality, formulation and computation of integer programming problems.
- Acquire the knowledge of optimality, formulation and computation of dynamic programming problems.
- Determine the optimum solution for non-linear programming problems.

UNIT I  LINEAR PROGRAMMING  9

UNIT II  TRANSPORTATION AND ASSIGNMENT PROBLEMS  9

UNIT III  INTEGER PROGRAMMING  9

UNIT IV  DYNAMIC PROGRAMMING PROBLEMS  9

UNIT V  NON-LINEAR PROGRAMMING PROBLEMS  9

TOTAL:45 PERIODS

OUTCOMES:
At the end of the course, students will be able to
- Could develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description, apply the simplex method for solving linear programming problems.
- Analyze the concept of developing, formulating, modeling and solving transportation and assignment problems.
- Solve the integer programming problems using various methods.
- Conceptualize the principle of optimality and sub-optimization, formulation and computational procedure of dynamic programming.
- Determine the optimum solution for non-linear programming problems.

TEXT BOOKS:
REFERENCES:

<table>
<thead>
<tr>
<th>CO1</th>
<th>PO 01</th>
<th>PO 02</th>
<th>PO 03</th>
<th>PO 04</th>
<th>PO 05</th>
<th>PO 06</th>
<th>PO 07</th>
<th>PO 08</th>
<th>PO 09</th>
<th>PO 10</th>
<th>PO 11</th>
<th>PO 12</th>
<th>PS 01</th>
<th>PS 02</th>
<th>PS 03</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>0.8</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OMA353 ALGEBRA AND NUMBER THEORY

OBJECTIVES:
- To introduce the basic notions of groups, rings, fields which will then be used to solve related problems.
- To examine the key questions in the Theory of Numbers.
- To give an integrated approach to number theory and abstract algebra, and provide a firm basis for further reading and study in the subject.

UNIT I GROUPS AND RINGS
Groups: Definition - Properties - Homomorphism - Isomorphism - Cyclic groups - Cosets - Lagrange's theorem.
Rings: Definition - Sub rings - Integral domain - Field - Integer modulo n - Ring homomorphism.

UNIT II FINITE FIELDS AND POLYNOMIALS
Rings - Polynomial rings - Irreducible polynomials over finite fields - Factorization of polynomials over finite fields.

UNIT III DIVISIBILITY THEORY AND CANONICAL DECOMPOSITIONS
Division algorithm- Base-b representations – Number patterns – Prime and composite numbers – GCD – Euclidean algorithm – Fundamental theorem of arithmetic – LCM.
UNIT IV DIOPHANTINE EQUATIONS AND CONGRUENCES
Linear Diophantine equations – Congruence’s – Linear Congruence’s - Applications : Divisibility tests - Modular exponentiation - Chinese remainder theorem – 2x2 linear systems.

UNIT V CLASSICAL THEOREMS AND MULTIPLICATIVE FUNCTIONS
Wilson’s theorem – Fermat’s Little theorem – Euler’s theorem – Euler’s Phi functions – Tau and Sigma functions.

OUTCOMES:
- Explain the fundamental concepts of advanced algebra and their role in modern mathematics and applied contexts.
- Demonstrate accurate and efficient use of advanced algebraic techniques.
- The students should be able to demonstrate their mastery by solving non-trivial problems related to the concepts, and by proving simple theorems about the, statements proven by the text

TEXT BOOKS:

REFERENCES:

<table>
<thead>
<tr>
<th>PO 01</th>
<th>PO 02</th>
<th>PO 03</th>
<th>PO 04</th>
<th>PO 05</th>
<th>PO 06</th>
<th>PO 07</th>
<th>PO 08</th>
<th>PO 09</th>
<th>PO 10</th>
<th>PO 11</th>
<th>PO 12</th>
<th>PS O1</th>
<th>PS O2</th>
<th>PS O3</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Avg</td>
<td>2.8</td>
<td>2.4</td>
<td>1.6</td>
<td>0.8</td>
<td>2.4</td>
<td>1</td>
<td>2.2</td>
<td>1</td>
<td>0.8</td>
<td>1</td>
<td>2.2</td>
<td>2.6</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

OMA354 LINEAR ALGEBRA
L T P C 3 0 0 3

COURSE OBJECTIVES:
- To test the consistency and solve system of linear equations.
- To find the basis and dimension of vector space.
- To obtain the matrix of linear transformation and its eigenvalues and eigenvectors.
- To find orthonormal basis of inner product space and find least square approximation.
- To find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.
UNIT I  MATRICES AND SYSTEM OF LINEAR EQUATIONS  9

UNIT II  VECTOR SPACES  9
Vector spaces over Real and Complex fields - Subspace – Linear space - Linear independence and dependence - Basis and dimension.

UNIT III  LINEAR TRANSFORMATION  9
Linear transformation - Rank space and null space - Rank and nullity - Dimension theorem– Matrix representation of linear transformation - Eigenvalues and eigenvectors of linear transformation – Diagonalization.

UNIT IV  INNER PRODUCT SPACES  9
Inner product and norms - Properties - Orthogonal, Orthonormal vectors - Gram Schmidt orthonormalization process - Least square approximation.

UNIT V  EIGEN VALUE PROBLEMS AND MATRIX DECOMPOSITION  9

TOTAL : 45 PERIODS

COURSE OUTCOMES:
After the completion of the course the student will be able to
1. Test the consistency and solve system of linear equations.
2. Find the basis and dimension of vector space.
3. Obtain the matrix of linear transformation and its eigenvalues and eigenvectors.
4. Find orthonormal basis of inner product space and find least square approximation.
5. Find eigenvalues of a matrix using numerical techniques and perform matrix decomposition.

TEXT BOOKS

REFERENCES
COURSE OBJECTIVE:
- Enable the Non-biological student’s to understand about the basics of life science and their pro and cons for living organisms.

UNIT I Bascs of microbes and its types
Introduction to microbes, existence of microbes, inventions of great scientist and history, types of microorganisms – Bacteria, Virus, Fungi.

UNIT II Microbial techniques
Sterilization – types – physical and chemical sterilization, Decontamination, Preservation methods, fermentation, Cultivation and growth of microbes, Diagnostic methods.

UNIT III Pathogenic microbes
Infectious Disease – Awareness, Causative agent, Prevention and control - Cholera, Dengu, Malaria, Diarrhea, Tuberculosis, Typhoid, Covid, HIV.

UNIT IV Beneficial microbes
Applications of microbes – Clinical microbiology, agricultural microbiology, Food Microbiology, Environmental Microbiology, Animal Microbiology, Marine Microbiology.

UNIT V Products from microbes
Fermented products – Fermented Beverages, Curd, Cheese, Mushroom, Agricultural products – Biopesticide, Biofertilizers, Vermicompost, Pharmaceutical products - Antibiotics, Vaccines

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course the students will be able to
1. Microbes and their types
2. Cultivation of microbes
3. Pathogens and control measures for safety
4. Microbes in different industry for economy.

TEXT BOOKS
OBJECTIVES:
- The objective is to offer basic concepts of biochemistry to students with diverse background in life sciences including but not limited to the structure and function of various biomolecules and their metabolism.

UNIT I  CARBOHYDRATES  9
Introduction to carbohydrate, classification, properties of monosaccharide, structural aspects of monosaccharides. Introduction to disaccharide (lactose, maltose, sucrose) and polysaccharide (Heparin, starch, and glycogen) biological function of carbohydrate.

UNIT II  LIPID AND FATTY ACIDS  9
Introduction to lipid, occurrence, properties, classification of lipid. Importance of phospholipids, sphingolipid and glycerolipid. Biological function of lipid. Fatty acid, Introduction, Nomenclature and classification of fatty acid Essential and non essential fatty acids.

UNIT III  AMINO ACIDS AND PROTEIN.  9

UNIT IV  NUCLEIC ACIDS  9
Introduction to nucleic acid, Difference between nucleotide and nucleoside, composition of DNA & RNA Structure of Nitrogen bases in DNA and RNA along with the nomenclature- DNA double helix (Watson and crick) model, types of DNA, RNA.

UNIT V  VITAMINS AND HORMONES  9

OUTCOMES:
- Students will learn about various kinds of biomolecules and their physiological role.
- Students will gain knowledge about various metabolic disorders and will help them to know the importance of various biomolecules in terms of disease correlation.

TOTAL: 45 PERIODS

TEXT BOOKS
REFERENCES

OBT354 FUNDAMENTALS OF CELL AND MOLECULAR BIOLOGY

OBJECTIVES:
- To provide knowledge on the fundamentals of cell biology.
- To understand the signalling mechanisms.
- Understand basic principles of molecular biology at intracellular level to regulate growth, division and development.

UNIT I INTRODUCTION TO CELL
Cell, cell wall and Extracellular Matrix (ECM), composition, cellular dimensions, Evolution, Organisation, differentiation of prokaryotic and Eukaryotic cells, Virus, bacteria, cyanobacteria, mycoplasma and prions.

UNIT II CELL ORGANELLES
Molecular organisation, biogenesis and functin Mitochondria, endoplasmic reticulam, golgi apparatus, plastids, chloroplast, leucoplast, centrosome, lysosome, ribosome, peroxisome, Nucleus and nucleolus. Endo membrane system, concept of compartmentalisation.

UNIT III BIO-MEMBRANE TRANSPORT

UNIT IV CELL CYCLE
Cell cycle- Cell division by mitosis and meosis, Comparision of meosis and mitosis, regulation of cell cycle, cell lysis, Cytokinesis, Cell signaling, Cell communication, Cell adhesion and Cell junction, cell cycle checkpoints.

UNIT V CENTRAL DOGMA

TOTAL: 45 PERIODS

OUTCOMES:
- Understanding of cell at structural and functional level.
• Understand the central dogma of life and its significance.
• Comprehend the basic mechanisms of cell division.

TEXTBOOKS:

REFERENCES:

OPEN ELECTIVE IV
OHS352 PROJECT REPORT WRITING L T P C 3 0 0 3

COURSE OBJECTIVE
The Course will enable Learners to,
• Understand the essentials of project writing.
• Perceive the difference between general writing and technical writing
• Assimilate the fundamental features of report writing.
• Understand the essential differences that exist between general and technical writing.
• Learn the structure of a technical and project report.

UNIT I

UNIT II

UNIT III
Structure of the Project Report: (Part 1) Framing a Title – Content – Acknowledgement – Funding Details -Abstract – Introduction – Aim of the Study – Background - Writing the research question - Need of the Study/Project Significance, Relevance – Determining the feasibility – Theoretical Framework.

UNIT IV

UNIT V

TOTAL: 45 PERIODS

OUTCOMES
By the end of the course, learners will be able to

- Write effective project reports.
- Use statistical tools with confidence.
- Explain the purpose and intention of the proposed project coherently and with clarity.
- Create writing texts to suit achieve the intended purpose.
- Master the art of writing winning proposals and projects.

CO-PO & PSO MAPPING

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

- 1-low, 2-medium, 3-high, - - - no correlation
- Note: The average value of this course to be used for program articulation matrix.

REFERENCES:

OMA355 ADVANCED NUMERICAL METHODS

UNIT I ALGEBRAIC EQUATIONS AND EIGENVALUE PROBLEM 9

UNIT II INTERPOLATION 9
Central difference: Stirling and Bessel's interpolation formulae; Piecewise spline interpolation: Piecewise linear, piecewise quadratic and cubic spline; Least square approximation for continuous data (upto 3rd degree).

UNIT III NUMERICAL METHODS FOR ORDINARY DIFFERENTIAL EQUATIONS 9
UNIT IV  FINITE DIFFERENCE METHODS FOR ELLIPTIC EQUATIONS  9
Laplace and Poisson’s equations in a rectangular region: Five point finite difference schemes - Leibmann’s iterative methods - Dirichlet’s and Neumann conditions – Laplace equation in polar coordinates: Finite difference schemes.

UNIT V  FINITE DIFFERENCE METHOD FOR TIME DEPENDENT PARTIAL DIFFERENTIAL EQUATIONS  9

TEXT BOOKS:

REFERENCES:

OBJECTIVES:
- To introduce the basic concepts of probability, one and two dimensional random variables with applications to engineering which can describe real life phenomenon.
- To understand the basic concepts of random processes which are widely used in communication networks.
- To acquaint with specialized random processes which are apt for modelling the real time scenario.
- To understand the concept of correlation and spectral densities.
To understand the significance of linear systems with random inputs.

UNIT I  RANDOM VARIABLES  9

UNIT II  RANDOM PROCESSES  9

UNIT III  SPECIAL RANDOM PROCESSES  9

UNIT IV  CORRELATION AND SPECTRAL DENSITIES  9

UNIT V  LINEAR SYSTEMS WITH RANDOM INPUTS  9
Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.

TOTAL: 45 PERIODS

OUTCOMES
Upon successful completion of the course, students should be able to:
- Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.
- Apply the concept random processes in engineering disciplines.
- Understand and apply the concept of correlation and spectral densities.
- Get an exposure of various distribution functions and help in acquiring skills in handling situations involving more than one variable.
- Analyze the response of random inputs to linear time invariant systems.

TEXT BOOKS

REFERENCES

278
OBJECTIVES:
- To provide necessary basic concepts in probability and random processes for applications such as random signals, linear systems in communication engineering.
- To understand the concept of queueing models and apply in engineering.
- To provide the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering.
- To study the system reliability and hazard function for series and parallel systems.
- To implement Markovian Techniques for availability and maintainability which opens up new avenues for research.

UNIT I RANDOM PROCESSES

UNIT II MARKOVIAN QUEUEING MODELS
Markovian queues – Birth and death processes – Single and multiple server queueing models – Little’s formula - Queues with finite waiting rooms.

UNIT III ADVANCED QUEUEING MODELS
M/G/1 queue – Pollaczek Khinchin formula - M/D/1 and M/E_k/1 as special cases – Series queues – Open Jackson networks.

UNIT IV SYSTEM RELIABILITY

UNIT V MAINTAINABILITY AND AVAILABILITY
Maintainability and Availability functions – Frequency of failures – Two Unit parallel system with repair – k out of m systems.

TOTAL: 45 PERIODS

OUTCOMES
Upon successful completion of the course, students should be able to:
- Enable the students to apply the concept of random processes in engineering disciplines.
- Students acquire skills in analyzing various queueing models.
- Students can understand and characterize phenomenon which evolve with respect to time in a probabilistic manner.
- Students can analyze reliability of the systems for various probability distributions.
- Students can be able to formulate problems using the maintainability and availability analyses by using theoretical approach.

TEXT BOOKS
OMG354 PRODUCTION AND OPERATIONS MANAGEMENT FOR ENTREPRENEURS

OBJECTIVES:

- To know the basic concept and function of Production and Operation Management for entrepreneurship.
- To understand the Production process and planning.
- To understand the Production and Operations Management Control for business owners.

UNIT I INTRODUCTION TO PRODUCTION AND OPERATIONS MANAGEMENT

Functions of Production Management - Relationship between production and other functions – Production management and operations management, Characteristics of modern production and operation management, organisation of production function, recent trends in production /operations management - production as an organisational function, decision making in production Operations research

UNIT II PRODUCTION & OPERATION SYSTEMS

Production Systems- principles – Models - CAD and CAM- Automation in Production - Functions and significance- Capacity and Facility Planning: Importance of capacity planning- Capacity measurement – Capacity Requirement Planning (CRP) process for manufacturing and service industry

UNIT III PRODUCTION & OPERATIONS PLANNING

Facility Planning – Location of facilities – Location flexibility – Facility design process and techniques – Location break even analysis-Production Process Planning: Characteristic of
production process systems – Steps for production process- Production Planning Control Functions – Planning phase- Action phase- Control phase - Aggregate production planning

UNIT IV PRODUCTION & OPERATIONS MANAGEMENT PROCESS 9

UNIT V CONTROLLING PRODUCTION & OPERATIONS MANAGEMENT 9

COURSE OUTCOMES
Upon completion of this course the learners will be able:
CO1: To understand the basics and functions of Production and Operation Management for business owners.
CO2: To learn about the Production & Operation Systems.
CO4: To known about the Production & Operations Management Processes in organisations.
CO5: To comprehend the techniques of controlling, Production and Operations in industries.

REFERENCES

OCE354 BASICS OF INTEGRATED WATER RESOURCES MANAGEMENT L T P C
3 0 0 3

OBJECTIVES
- To introduce the interdisciplinary approach of water management.
- To develop knowledge base and capacity building on IWRM.

UNIT I OVERVIEW OF IWRM 9

UNIT II WATER USE SECTORS: IMPACTS AND SOLUTION 9
Water users: People, Agriculture, ecosystem and others - Impacts of the water use sectors on water resources - Securing water for people, food production, ecosystems and other uses - IWRM relevance in water resources management.
UNIT III  WATER ECONOMICS  
Economic characteristics of water good and services – Economic instruments – Private sector involvement in water resources management - PPP experiences through case studies.

UNIT IV  RECENT TRENDS IN WATER MANAGEMENT  
River basin management - Ecosystem Regeneration – 5 Rs - WASH - Sustainable livelihood - Water management in the context of climate change.

UNIT V  IMPLEMENTATION OF IWRM  
Barriers to implementing IWRM - Policy and legal framework - Bureaucratic reforms and inclusive development - Institutional Transformation - Capacity building - Case studies on conceptual framework of IWRM.

TOTAL: 45 PERIODS

OUTCOMES
On completion of the course, the student will be able to apply appropriate management techniques towards managing the water resources.

CO1 Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management.

CO2 Discuss on the different water uses; how it is impacted and ways to tackle these impacts.

CO3 Explain the economic aspects of water and choose the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies.

CO4 Illustrate the recent trends in water management.

CO5 Understand the implementation hitches and the institutional frameworks.

TEXT BOOKS

REFERENCES
2. IWRM Guidelines at River Basin Level (UNESCO, 2008).

OMG355  MULTIVARIATE DATA ANALYSIS

OBJECTIVE:
• To know various multivariate data analysis techniques for business research.

UNIT I  INTRODUCTION
Uni-variate, Bi-variate and Multi-variate techniques – Classification of multivariate techniques – Guidelines for multivariate analysis and interpretation.

UNIT II  PREPARING FOR MULTIVARIATE ANALYSIS
Conceptualization of research model with variables, collection of data – Approaches for dealing with missing data – Testing the assumptions of multivariate analysis.
UNIT III  MULTIPLE LINEAR REGRESSION ANALYSIS, FACTOR ANALYSIS  9
Multiple Linear Regression Analysis – Inferences from the estimated regression function –
Validation of the model. -Approaches to factor analysis – interpretation of results.

UNIT IV  LATENT VARIABLE TECHNIQUES  9
Confirmatory Factor Analysis, Structural equation modelling, Mediation models, Moderation models,
Longitudinal studies.

UNIT V  ADVANCED MULTIVARIATE TECHNIQUES  9
Multiple Discriminant Analysis, Logistic Regression, Cluster Analysis, Conjoint Analysis,
multidimensional scaling.

TOTAL: 45 PERIODS

OUTCOMES:
- Demonstrate a sophisticated understanding of the concepts and methods; know the exact
  scopes and possible limitations of each method; and show capability of using multivariate
  techniques to provide constructive guidance in decision making.
- Use advanced techniques to conduct thorough and insightful analysis, and interpret the results
  correctly with detailed and useful information.
- Show substantial understanding of the real problems; conduct deep analysis using correct
  methods; and draw reasonable conclusions with sufficient explanation and elaboration.
- Write an insightful and well-organized report for a real-world case study, including thoughtful
  and convincing details.
- Make better business decisions by using advanced techniques in data analytics.

REFERENCES :
1. Joseph F Hair, Rolph E Anderson, Ronald L. Tatham & William C. Black, Multivariate Data
   Hall, New Delhi, 2005.
4. David R Anderson, Dennis J Seveency, and Thomas A Williams, Statistics for Business and
   Economics, Thompson, Singapore, 2002

OCE353  LEAN CONCEPTS, TOOLS AND PRACTICES  L T P C
3  0  0  3

OBJECTIVE:
- To impart knowledge about the basics of lean principles, tools and techniques, and
  implementation in the construction industry.

UNIT I  INTRODUCTION  9
Introduction and overview of the construction project management - Review of Project Management
& Productivity Measurement Systems - Productivity in Construction - Daily Progress Report-The
state of the industry with respect to its management practices - construction project phases - The
problems with current construction management techniques.

UNIT II  LEAN MANAGEMENT  9
Introduction to lean management - Toyota’s management principle-Evolution of lean in construction
industry - Production theories in construction –Lean construction value - Value in construction -
Target value design - Lean project delivery system - Forms of waste in construction industry - Waste Elimination.

**UNIT III  CORE CONCEPTS IN LEAN** 9

**UNIT IV LEAN TOOLS AND TECHNIQUES** 9

**UNIT V LEAN IMPLEMENTATION IN CONSTRUCTION INDUSTRY** 9
Lean construction implementation - Enabling lean through information technology - Lean in design - Design Structure - BIM (Building Information Modelling) - IPD (Integrated Project Delivery) – Sustainability through lean construction approach.

**OUTCOMES:**
On completion of this course, the student is expected to be able to

**CO1** Explains the contemporary management techniques and the issues in present scenario.

**CO2** Apply the basics of lean management principles and their evolution from manufacturing industry to construction industry.

**CO3** Develops a better understanding of core concepts of lean construction tools and techniques and their importance in achieving better productivity.

**CO4** Apply lean techniques to achieve sustainability in construction projects.

**CO5** Apply lean construction techniques in design and modeling.

**REFERENCES:**

**OME352 ADDITIVE MANUFACTURING**

**COURSE OBJECTIVES:**
To introduce the development, capabilities, applications, of Additive Manufacturing (AM), and its business opportunities.
To be acquainted with vat polymerization and material extrusion processes
To be familiar with powder bed fusion and binder jetting processes.
To gain knowledge on applications of direct energy deposition, and material jetting processes.
To impart knowledge on sheet lamination and direct write technologies.
UNIT I INTRODUCTION

UNIT II VAT POLYMERIZATION AND MATERIAL EXTRUSION

UNIT III POWDER BED FUSION AND BINDER JETTING

UNIT IV MATERIAL JETTING AND DIRECTED ENERGY DEPOSITION

UNIT V SHEET LAMINATION AND DIRECT WRITE TECHNOLOGY
Ink-Based Direct Writing (DW): Nozzle Dispensing Processes, Inkjet Printing Processes, Aerosol DW - Applications of DW.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course students shall be able to:
CO1: Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.
CO2: Acquire knowledge on process vat polymerization and material extrusion processes and its applications.
CO3: Elaborate the process and applications of powder bed fusion and binder jetting.
CO4: Evaluate the advantages, limitations, applications of material jetting and directed energy deposition processes.
CO5: Acquire knowledge on sheet lamination and direct write technology.

TEXT BOOKS:

REFERENCES:


OME343 NEW PRODUCT DEVELOPMENT

COURSE OBJECTIVES

1. To introduce the fundamental concepts of the new product development
2. To develop material specifications, analysis and process.
3. To Learn the Feasibility Studies & reporting of new product development.
4. To study the New product qualification and Market Survey on similar products of new product development
   To learn Reverse Engineering. Cloud points generation, converting cloud data to 3D model

UNIT – I FUNDAMENTALS OF NPD


UNIT – II MATERIAL SPECIFICATIONS, ANALYSIS & PROCESS

Material specification standards – ISO, DIN, JIS, ASTM, EN, etc. – Awareness on various manufacturing process like Metal castings & Forming, Machining (Conventional, 3 Axis, 4 Axis, 5 Axis, ), Fabrications, Welding process. Qualifications of parts mechanical, physical & Chemical properties and their test report preparation and submission. Fundamentals of DFMEA & PFMEA, Fundamentals of FEA, Bend Analysis, Hot Distortion, Metal and Material Flow, Fill and Solidification analysis.

UNIT – III ESSENTIALS OF NPD


UNIT – IV CRITERIONS OF NPD

New product qualification for Dimensions, Mechanical & Physical Properties, Internal Soundness proving through X-Ray, Radiography, Ultrasonic Testing, MPT, etc. Agreement with customer for testing frequencies. Market Survey on similar products, Risk analysis, validating samples with simulation results, Lesson Learned & Horizontal deployment in NPD.
UNIT – V REPORTING & FORWARD-THINKING OF NPD

Detailed study on PPAP with 18 elements reporting, APQP and its 5 Sections, APQP vs PPAP, Importance of SOP (Standard Operating Procedure) – Purpose & documents, deployment in shop floor. Prototyping & RPT - Concepts, Application and its advantages, 3D Printing – resin models, Sand cores for foundries; Reverse Engineering. Cloud points generation, converting cloud data to 3D model – Advantages & Limitation of RE, CE (Concurrent Engineering) – Basics, Application and its advantages in NPD (to reduce development lead time, time to Market, Improve productivity and product cost.)

TOTAL :45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Discuss fundamental concepts and customer specific requirements of the New Product development
2. Discuss the Material specification standards, analysis and fabrication, manufacturing process.
3. Develop Feasibility Studies & reporting of New Product development
4. Analyzing the New product qualification and Market Survey on similar products of new product development
5. Develop Reverse Engineering. Cloud points generation, converting cloud data to 3D model

TEXT BOOKS:
1. Product Development – Sten Jonsson
2. Product Design & Development – Karl T. Ulrich, Maria C. Young, Steven D. Eppinger

REFERENCES:
1. Revolutionizing Product Development – Steven C Wheelwright & Kim B. Clark
2. Change by Design
5. Product Design & Value Engineering – Dr. M.A. Bulsara &Dr. H.R. Thakkar

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

Low (1) ; Medium (2) ; High (3)
OBJECTIVES:
The course aims to
- Outline Fundamental concepts in UI & UX
- Introduce the principles of Design and Building an mobile app
- Illustrate the use of CAD in product design
- Outline the choice and use of prototyping tools
- Understanding design of electronic circuits and fabrication of electronic devices

UNIT I        UI/UX  9

UNIT II              APP DEVELOPMENT  9
SDLC - Introduction to App Development - Types of Apps - web Development - understanding Stack - Frontend - backend - Working with Databases - Introduction to API - Introduction to Cloud services - Cloud environment Setup - Reading and writing data to cloud - Embedding ML models to Apps - Deploying application.

UNIT III             INDUSTRIAL DESIGN  9
Introduction to Industrial Design - Points, lines, and planes - Sketching and concept generation - Sketch to CAD - Introduction to CAD tools - Types of 3D modeling - Basic 3D Modeling Tools - Part creation – Assembly - Product design and rendering basics - Dimensioning & Tolerancing

UNIT IV           MECHANICAL RAPID PROTOTYPING  9
Need for prototyping - Domains in prototyping - Difference between actual manufacturing and prototyping - Rapid prototyping methods - Tools used in different domains - Mechanical Prototyping; 3D Printing and classification - Laser Cutting and engraving - RD Works - Additive manufacturing

UNIT V          ELECTRONIC RAPID PROTOTYPING  9
Basics of electronic circuit design - lumped circuits - Electronic Prototyping - Working with simulation tool - simple PCB design with EDA

TOTAL: 45 PERIODS

COURSE OUTCOMES
At the end of the course, learners will be able to:
- Create quick UI/UX prototypes for customer needs
- Develop web application to test product traction / product feature
- Develop 3D models for prototyping various product ideas
- Built prototypes using Tools and Techniques in a quick iterative methodology

TEXT BOOKS
REFERENCES

MF3010 MICRO AND PRECISION ENGINEERING  LT P C  3 0 0 3

COURSE OBJECTIVES:
At the end of this course the student should be able to
- Learn about the precision machine tools
- Learn about the macro and micro components.
- Understand handling and operating of the precision machine tools.
- Learn to work with miniature models of existing machine tools/robots and other instruments.
- Learn metrology for micro system

UNIT I  INTRODUCTION TO MICROSYSTEMS  9
Design, and material selection, micro-actuators: hydraulic, pneumatic, electrostatic/ magnetic etc. for medical to general purpose applications. Micro-sensors based on Thermal, mechanical, electrical properties; micro-sensors for measurement of pressure, flow, temperature, inertia, force, acceleration, torque, vibration, and monitoring of manufacturing systems.

UNIT II  FABRICATION PROCESSES FOR MICRO-SYSTEMS  9
Additive, subtractive, forming process, microsystems-Micro-pumps, micro- turbines, micro engines, micro-robot, and miniature biomedical devices

UNIT III  INTRODUCTION TO PRECISION ENGINEERING  9
Machine tools, holding and handling devices, positioning fixtures for fabrication/ assembly of microsystems. Precision drives: inch worm motors, ultrasonic motors, stick- slip mechanism and other piezo-based devices.

UNIT IV  PRECISION MACHINING PROCESSES  9
Precision machining processes for macro components - Diamond turning, fixed and free abrasive processes, finishing processes.

UNIT V  METROLOGY FOR MICRO SYSTEMS  9
Metrology for micro systems - Surface integrity and its characterization.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon the completion of this course the students will be able to
- Select suitable precision machine tools and operate
- Apply the macro and micro components for fabrication of micro systems.
- Apply suitable machining process
- Able to work with miniature models of existing machine tools/robots and other instruments.
- Apply metrology for micro system
TEXT BOOKS:

REFERENCES:

OMF354 COST MANAGEMENT OF ENGINEERING PROJECTS LT P C
3 0 0 3

COURSE 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 9
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 9
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 9
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 9
UNIT – V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
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.

TEXT BOOKS:

REFERENCES:

OAS353 SPACE VEHICLES L T P C

OBJECTIVES:
- To interpret the missile space stations, space vs earth environment.
- To explain the life support systems, mission logistics and planning.
- To deploy the skills effectively in the understanding of space vehicle configuration design.
- To explain Engine system and support of space vehicle
- To interpret nose cone configuration of space vehicle

UNIT I FUNDAMENTAL ASPECTS 9
Energy and Efficiencies of power plants for space vehicles – Typical Performance Values – Mission design – Structural design aspects during launch - role of launch environment on launch vehicle integrity.

UNIT II SELECTION OF ROCKET PROPULSION SYSTEMS 9
Ascent flight mechanics – Launch vehicle selection process – Criteria for Selection for different missions – selection of subsystems – types of staging – Interfaces – selection and criteria for stages and their role in launch vehicle configuration design.
UNIT III ENGINE SYSTEMS, CONTROLS, AND INTEGRATION

UNIT IV THRUST VECTOR CONTROL
TVC Mechanisms with a Single Nozzle – TVC with Multiple Thrust Chambers or Nozzles – Testing – Integration with Vehicle – SITVC method – other jet control methods - exhaust plume problems in space environment

UNIT V NOSE CONE CONFIGURATION
Aerodynamic aspects on the selection of nose shape of a launch vehicle - design factors in the finalization of nose configuration with respect to payload - nose cone thermal protection system - separation of fairings - payload injection mechanism

TOTAL: 45 PERIODS

OUTCOMES:
On successful completion of this course, the student will be able to
- Explain exotic space propulsion concepts, such as nuclear, solar sail, and antimatter.
- Apply knowledge in selecting the appropriate rocket propulsion systems.
- Interpret the air-breathing propulsion suitable for initial stages and fly-back boosters.
- Analyze aerodynamics aspect, including boost-phase lift and drag, hypersonic, and re-entry.
- Adapt from aircraft engineers moving into launch vehicle, spacecraft, and hypersonic vehicle design.
COURSE OBJECTIVES:
Of this course are
- To introduce fundamental concepts of management and organization to students.
- To impart knowledge to students on various aspects of marketing, quality control and marketing strategies.
- To make students familiarize with the concepts of human resources management.
- To acquaint students with the concepts of project management and cost analysis.
- To make students familiarize with the concepts of planning process and business strategies.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANISATION 9

UNIT II OPERATIONS AND MARKETING MANAGEMENT 9

UNIT III HUMAN RESOURCES MANAGEMENT 9
Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR, Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development, Wage and Salary Administration, Promotion, Transfer, Performance Appraisal, Grievance Handling and Welfare Administration, Job Evaluation and Merit Rating - Capability Maturity Model (CMM) Levels.

UNIT IV PROJECT MANAGEMENT 9
Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing (simple problems).

UNIT V STRATEGIC MANAGEMENT AND CONTEMPORARY STRATEGIC ISSUES 9

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of the course, Students will be able to
CO1: Plan an organizational structure for a given context in the organization to carry out production operations through Work-study.
CO2: Survey the markets, customers and competition better and price the given products appropriately.
CO3: Ensure quality for a given product or service.
CO4: Plan, schedule and control projects through PERT and CPM.
CO5: Evaluate strategies for a business or service organization.

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Avg.</td>
<td>3</td>
<td>2.6</td>
</tr>
</tbody>
</table>

TEXT BOOKS:

REFERENCES:

OIM353 PRODUCTION PLANNING AND CONTROL

COURSE OBJECTIVES:
- To understand the concept of production planning and control act work study.
- To apply the concept of product planning,
- To analyze the production scheduling,
- To apply the Inventory Control concepts.
- To prepare the manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).
UNIT I  INTRODUCTION
Objectives and benefits of planning and control-Functions of production control-Types of production- job- batch and continuous-Product development and design-Marketing aspect -Functional aspects- Operational aspect-Durability and dependability aspect aesthetic aspect. Profit consideration- Standardization, Simplification & specialization- Break even analysis-Economics of a new design.

UNIT II  WORK STUDY
Method study, basic procedure-Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study – work measurement - Techniques of work measurement - Time study - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNIT III  PRODUCT PLANNING AND PROCESS PLANNING
Product planning-Extending the original product information-Value analysis-Problems in lack of product planning-Process planning and routing-Pre requisite information needed for process planning- Steps in process planning-Quantity determination in batch production-Machine capacity, balancing- Analysis of process capabilities in a multi product system.

UNIT IV  PRODUCTION SCHEDULING

UNIT V  INVENTORY CONTROL AND RECENT TRENDS IN PPC
Inventory control-Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system - Ordering cycle system-Determination of Economic order quantity and economic lot size- ABC analysis - Recorder procedure-Introduction to computer integrated production planning systems- elements of JUST IN TIME SYSTEMS-Fundamentals of MRP II and ERP.

COURSE OUTCOMES:
Upon completion of this course,
CO1: The students can able to prepare production planning and control act work study,
CO2: The students can able to prepare product planning,
CO3: The students can able to prepare production scheduling,
CO4: The students can able to prepare Inventory Control.
CO5: They can plan manufacturing requirements manufacturing requirement Planning (MRP II) and Enterprise Resource Planning (ERP).

TEXT BOOKS:

REFERENCES

TOTAL: 45 PERIODS
7. Samson Eilon, “Elements of Production Planning and Control”, Universal Book Corp.1984

<table>
<thead>
<tr>
<th>CO’s</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’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td></td>
<td>3</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></td>
<td>2</td>
<td>2</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>3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>AVG.</td>
<td>3</td>
<td>2.6</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OIE353 OPERATIONS MANAGEMENT

COURSE OBJECTIVE:  
- Recognize and appreciate the concept of Production and Operations Management in creating and enhancing a firm’s competitive advantages.
- Describe the concept and contribution of various constituents of Production and Operations Management (both manufacturing and service).
- Relate the interdependence of the operations function with the other key functional areas of a firm.
- Teach analytical skills and problem-solving tools to the analysis of the operations problems.
- Apply scheduling and Lean Concepts for improving System Performance.

UNIT I INTRODUCTION TO OPERATIONS MANAGEMENT
Operations Management – Nature, Importance, historical development, transformation processes, differences between services and goods, a system perspective, functions, challenges, current priorities, recent trends; Operations Strategy – Strategic fit, framework; Supply Chain Management

UNIT II FORECASTING, CAPACITY AND FACILITY DESIGN

UNIT III DESIGN OF PRODUCT, PROCESS AND WORK SYSTEMS
Measurement and Productivity – Measuring Productivity and Methods to improve productivity.

UNIT IV MATERIALS MANAGEMENT

UNIT V SCHEDULING AND PROJECT MANAGEMENT
Project Management – Scheduling Techniques, PERT, CPM; Scheduling - work centers – nature, importance; Priority rules and techniques, shopfloor control; Flow shop scheduling – Johnson’s Algorithm – Gantt charts; personnel scheduling in services.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: The students will appreciate the role of Production and Operations management in enabling and enhancing a firm’s competitive advantages in the dynamic business environment.
CO2: The students will obtain sufficient knowledge and skills to forecast demand for Production and Service Systems.
CO3: The students will be able to Formulate and Assess Aggregate Planning strategies and Material Requirement Plan.
CO4: The students will be able to develop analytical skills to calculate capacity requirements and developing capacity alternatives.
CO5: The students will be able to apply scheduling and Lean Concepts for improving System Performance.

CO’s- PO’s & PSO’s MAPPING

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>AVg.</td>
<td>2.6</td>
<td>2</td>
</tr>
</tbody>
</table>

TEXT BOOKS

REFERENCES

OSF352 INDUSTRIAL HYGIENE L T P C
3 0 0 3

COURSE OBJECTIVES:
1. Demonstrate an understanding of how occupational hygiene standards are set and used in work health and safety.
2. Compare and contrast the roles of environmental and biological monitoring in work health and safety.
3. Outline strategies for identifying, assessing and controlling risks associated with airborne gases, vapours and particulates.
4. Discuss how personal protective equipment can be used to reduce risks associated with workplace exposures.
5. Provide high-level advice on managing and controlling noise and noise-related hazards.

UNIT I INTRODUCTION AND SCOPE

UNIT II MONITORING FOR SAFETY, HEALTH & ENVIRONMENT

UNIT III OCCUPATIONAL HEALTH AND ENVIRONMENTAL SAFETY EDUCATION

UNIT IV OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT

UNIT V INDUSTRIAL HAZARDS
**COURSE OUTCOMES:**

Students able to

CO1: Explain and apply human factors engineering concepts in both evaluation of existing systems and design of new systems

CO2: Specify designs that avoid occupation related injuries

CO3: Define and apply the principles of work design, motion economy, and work environment design.

CO4: Identify the basic human sensory, cognitive, and physical capabilities and limitations with respect to human-machine system performance.

CO5: Acknowledge the impact of workplace design and environment on productivity

**TEXT BOOKS:**


**REFERENCES:**

3. Industrial Safety - National Safety Council of India

**CO’s- PO’s & PSO’s MAPPING**

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO’s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AVg.</td>
<td>2</td>
<td>-</td>
</tr>
</tbody>
</table>

**OSF353 CHEMICAL PROCESS SAFETY**

**COURSE OBJECTIVES**

- Teach the principles of safety applicable to the design, and operation of chemical process plants.
Ensure that potential hazards are identified and mitigation measures are in place to prevent unwanted release of energy.

Learn about the hazardous chemicals into locations that could expose employees and others to serious harm.

Focuses on preventing incidents and accidents during large scale manufacturing of chemicals and pharmaceuticals.

Ensure that the general design of the plant is capable of complying with the dose limits in force and with the radioactive releases.

UNIT I SAFETY IN THE STORAGE AND HANDLING OF CHEMICALS AND GASES 9
Types of storage-general considerations for storage layouts- atmospheric venting, pressure and temperature relief - relief valve sizing calculations - storage and handling of hazardous chemicals and industrial gases, safe disposal methods, reaction with other chemicals, hazards during transportation - pipe line transport - safety in chemical laboratories.

UNIT II CHEMICAL REACTION HAZARDS 9
Hazardous inorganic and organic reactions and processes, Reactivity as a process hazard, Detonations, Deflagrations, and Runaways, Assessment and Testing strategies, Self - heating hazards of solids, Explosive potential of chemicals, Structural groups and instability of chemicals, Thermochemical screening.

UNIT III SAFETY IN THE DESIGN OF CHEMICAL PROCESS PLANTS 9
Design principles -Process design development - types of designs, feasibility survey, preliminary design, Flow diagrams, piping and instrumentation diagram, batch versus continuous operation, factors in equipment scale up and design, equipment specifications - reliability and safety in designing - inherent safety - engineered safety - safety during startup and shutdown - non destructive testing methods - pressure and leak testing - emergency safety devices - scrubbers and flares- new concepts in safety design and operation- Pressure vessel testing standards- Inspection techniques for boilers and reaction vessels.

UNIT IV SAFETY IN THE OPERATION OF CHEMICAL PROCESS PLANTS 9
Properties of chemicals - Material Safety Data Sheets - the various properties and formats used - methods available for property determination. Operational activities and hazards - standards operating procedures - safe operation of pumps, compressors, heaters, column, reactors, pressure vessels, storage vessels, piping systems - effects of pressure, temperature, Flow rate and humidity on operations - corrosion and control measures-condition monitoring - control valves - safety valves - pressure reducing valves, drains, bypass valves, inert gases. Chemical splashes, eye irrigation and automatic showers.

UNIT V SAFETY AND ANALYSIS 9
Safety vs reliability- quantification of basic events, system safety quantification, Human error analysis, Accident investigation and analysis, OSHAS 18001 and OSHMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Students able to
**COURSE OBJECTIVES:**

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

- Understanding the importance of various materials used in electrical, electronics and magnetic applications.
- Acquiring knowledge on the properties of electrical, electronics and magnetic materials.
- Gaining knowledge on the selection of suitable materials for the given application.
- Knowing the fundamental concepts in Semiconducting materials.
- Getting equipped with the materials used in optical and optoelectronic applications.

**UNIT I  DIELECTRIC MATERIALS**
Dielectric as Electric Field Medium, leakage currents, dielectric loss, dielectric strength, breakdown voltage, breakdown in solid dielectrics, flashover, liquid dielectrics, electric conductivity in solid, liquid and gaseous dielectrics, Ferromagnetic materials, properties of ferromagnetic materials in static fields, spontaneous, polarization, curie point, anti-ferromagnetic materials, piezoelectric materials, pyroelectric materials.

UNIT II      MAGNETIC MATERIALS
Classification of magnetic materials, spontaneous magnetization in ferromagnetic materials, magnetic Anisotropy, Magnetostriction, diamagnetism, magnetically soft and hard materials, special purpose materials, feebly magnetic materials, Ferrites, cast and cermet permanent magnets, ageing of magnets. Factors effecting permeability and Hysteresis

UNIT III     SEMICONDUCTOR MATERIALS
Properties of semiconductors, Silicon wafers, integration techniques, Large and very large scale Integration techniques. Concept of superconductivity; theories and examples for high temperature superconductivity; discussion on specific superconducting materials; comments on fabrication and engineering applications.

UNIT IV      MATERIALS FOR ELECTRICAL APPLICATIONS
Materials used for Resistors, rheostats, heaters, transmission line structures, stranded conductors, bimetals fuses, soft and hard solders, electric contact materials, electric carbon materials, thermocouple materials. Solid, Liquid and Gaseous insulating materials, Effect of moisture on insulation.

UNIT V       OPTICAL AND OPTOELECTRONIC MATERIALS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to
- Understand various types of dielectric materials, their properties in various conditions.
- Evaluate magnetic materials and their behavior.
- Evaluate semiconductor materials and technologies.
- Select suitable materials for electrical engineering applications.
- Identify right material for optical and optoelectronic applications

TEXT BOOKS:

REFERENCES:
COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Understanding the evolution of nanomaterials in the scientific era and make them to understand different types of nanomaterials for the future engineering applications
2. Gaining knowledge on dimensionality effects on different properties of nanomaterials
3. Getting acquainted with the different processing techniques employed for fabricating nanomaterials
4. Having knowledge on the different characterisation techniques employed to characterise the nanomaterials
5. Acquiring knowledge on different applications of nanomaterials in different disciplines of engineering.

UNIT I     NANOMATERIALS  9
Introduction, Classification: 0D, 1D, 2D, 3D nanomaterials and nano-composites, their mechanical, electrical, optical, magnetic properties; Nanomaterials versus bulk materials.

UNIT II    THERMODYNAMICS & KINETICS OF NANOSTRUCTURED MATERIALS  9
Size and interface/interphase effects, interfacial thermodynamics, phase diagrams, diffusivity, grain growth, and thermal stability of nanomaterials.

UNIT III   PROCESSING  9
Bottom-up and top-down approaches for the synthesis of nanomaterials, mechanical alloying, chemical routes, severe plastic deformation, and electrical wire explosion technique.

UNIT IV    STRUCTURAL CHARACTERISTICS  9
Principles of emerging nanoscale X-ray techniques such as small angle X-ray scattering and X-ray absorption fine structure (XAFS), electron and neutron diffraction techniques and their application to nanomaterials; SPM, Nanoindentation, Grain size, phase formation, texture, stress analysis

UNIT V     APPLICATIONS  9
Applications of nanoparticles, quantum dots, nanotubes, nanowires, nanocoatings; applications in electronic, electrical and medical industries

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to
1. Evaluate nanomaterials and understand the different types of nanomaterials
2. Recognise the effects of dimensionality of materials on the properties
3. Process different nanomaterials and use them in engineering applications
4. Use appropriate techniques for characterising nanomaterials
5. Identify and use different nanomaterials for applications in different engineering fields.

**TEXT BOOKS:**

**REFERENCES:**

<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>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>C01</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>C02</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C03</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C04</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>C05</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Avg</td>
<td>2.8</td>
<td>1.6</td>
<td>1.7</td>
<td>2.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.8</td>
<td>2</td>
<td>1.3</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:
1. To knowledge on fluid power principles and working of hydraulic pumps
2. To obtain the knowledge in hydraulic actuators and control components
3. To understand the basics in hydraulic circuits and systems
4. To obtain the knowledge in pneumatic and electro pneumatic systems
5. To apply the concepts to solve the trouble shooting

UNIT I  FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS  9

UNIT II  HYDRAULIC ACTUATORS AND CONTROL COMPONENTS  9

UNIT III  HYDRAULIC CIRCUITS AND SYSTEMS  9
accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT IV  PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS  9

UNIT V  TROUBLE SHOOTING AND APPLICATIONS  9

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO 1: Analyze the methods in fluid power principles and working of hydraulic pumps
CO 2: Recognize the concepts in hydraulic actuators and control components
CO 3: Obtain the knowledge in basics of hydraulic circuits and systems
CO 4: Know about the basics concept in pneumatic and electro pneumatic systems
CO 5: Apply the concepts to solve the trouble shooting hydraulic and pneumatics

### Mapping of COs with POs and PSOs

<table>
<thead>
<tr>
<th>COs/POs &amp; PSOs</th>
<th>POs</th>
<th>PSOs</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO/PO &amp; PSO Average</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

1 – Slight, 2 – Moderate, 3 – Substantial

### TEXT BOOKS

### REFERENCES

### COURSE OBJECTIVES:
1. To learn the various types of sensors, transducers, sensor output signal types, calibration techniques, formulation of system equation and its characteristics.
2. To understand basic working principle, construction, Application and characteristics of displacement, speed and ranging sensors.
3. To understand and analyze the working principle, construction, application and characteristics of force, magnetic and heading sensors.
4. To learn and analyze the working principle, construction, application and characteristics of optical, pressure, temperature and other sensors.
5. To familiarize students with different signal conditioning circuits design and data acquisition system.

### UNIT I SENSOR CLASSIFICATION, CHARACTERISTICS AND SIGNAL TYPES

Sensor Calibration Techniques – Sensor Outputs - Signal Types - Analog and Digital Signals, PWM and PPM.

UNIT II

DISPLACEMENT, PROXIMITY AND RANGING SENSORS


UNIT III

FORCE, MAGNETIC AND HEADING SENSORS


UNIT IV

OPTICAL, PRESSURE, TEMPERATURE AND OTHER SENSORS

Photo Conductive Cell, Photo Voltaic, Photo Resistive, LDR – Fiber Optic Sensors – Pressure – Diaphragm – Bellows - Piezoelectric - Piezo-resistant - Acoustic, Temperature – IC, Thermistor, RTD, Thermocouple – Non Contact Sensor - Chemical Sensors - MEMS Sensors - Smart Sensors.

UNIT V

SIGNAL CONDITIONING


TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, students should be able to:

CO1: Understand various sensor effects, sensor characteristics, signal types, calibration methods and obtain transfer function and empirical relation of sensors. They can also analyze the sensor response.

CO2: Analyze and select suitable sensor for displacement, proximity and range measurement.

CO3: Analyze and select suitable sensor for force, magnetic field, speed, position and direction measurement.

CO4: Analyze and Select suitable sensor for light detection, pressure and temperature measurement and also familiar with other miniaturized smart sensors.

CO5: Select and design suitable signal conditioning circuit with proper compensation and linearizing element based on sensor output signal.

Mapping of COs with POs and PSOs

<table>
<thead>
<tr>
<th>COs/POs &amp; PSOs</th>
<th>POs</th>
<th>PSOs</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3 3 2</td>
<td>1 2 3</td>
</tr>
<tr>
<td>CO2</td>
<td>3 3 2</td>
<td>1 1 1</td>
</tr>
<tr>
<td>CO3</td>
<td>3 3 2</td>
<td>1 1 1</td>
</tr>
<tr>
<td>CO4</td>
<td>3 3 2</td>
<td>1 1 1</td>
</tr>
<tr>
<td>CO5</td>
<td>3 3 2</td>
<td>1 1 1</td>
</tr>
<tr>
<td>CO/PO &amp; PSO A</td>
<td>3 3 2</td>
<td>0.8 0.8 0.8</td>
</tr>
</tbody>
</table>

1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS

REFERENCES:

ORA352 CONCEPTS IN MOBILE ROBOTS

COURSE OBJECTIVES
1. To introduce mobile robotic technology and its types in detail.
2. To learn the kinematics of wheeled and legged robot.
3. To familiarize the intelligence into the mobile robots using various sensors.
4. To acquaint the localization strategies and mapping technique for mobile robot.
5. To aware the collaborative mobile robotics in task planning, navigation and intelligence.

UNIT – I INTRODUCTION TO MOBILE ROBOTICS

UNIT – II KINEMATICS

UNIT – III PERCEPTION

UNIT – IV LOCALIZATION

UNIT – V PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: Evaluate the appropriate mobile robots for the desired application.
CO2: Create the kinematics for given wheeled and legged robot.
CO3: Analyse the sensors for the intelligence of mobile robotics.
CO4: Create the localization strategies and mapping technique for mobile robot.
CO5: Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications.

TEXT BOOKS

REFERENCES:

MV3501 MARINE PROPULSION L T P C 3 0 0 3

COURSE OBJECTIVES:
1. To impart knowledge on basics of propulsion system and ship dynamic movements
2. To educate them on basic layout and propulsion equipment’s
3. To impart basic knowledge on performance of the ship
4. To impart basic knowledge on Ship propeller and its types
5. To impart knowledge on ship rudder and its types

UNIT I BASICS SHIP PROPULSION SYSTEM AND EQUIPMENTS 9
law of floatation - Basics principle of propulsion- Earlier methods of propulsion- ship propulsion machinery- boiler, Marine steam engine, diesel engine, ship power transmission system, ship dynamic structure, Marine propulsion equipment - shaft tunnel, Intermediate shaft and bearing, stern tube, stern tube sealing etc. degree of freedom, Modern propelling methods- water jet propulsion, screw propulsion.

UNIT II SHIPS MOVEMENTS AND SHIP STABILIZATION 9
Thrust augmented devices, Ship hull, modern ship propulsion design, bow thruster – Advantages, various methods to stabilize the ship- passive and active stabilizer, fin stabilizer, bilge keel - stabilizing and securing ship in port- effect of tides on ship – effect of river water and sea water sailing vessel, Load line and load line of marking- draught markings.
UNIT III SHIPS SPEED AND ITS PERFORMANCE
Ship propulsion factors, factors affecting ships speed, various velocities of ship, hull drag, effects of fouling on ships hull, ship wake, relation between powers, Fuel consumption of ship, cavitations - effects of cavitation’s, ship turning radius.

UNIT IV BASICS OF PROPELLER

UNIT V BASICS OF RUDDER
Rudder dimension, Area of rudder and its design, Rudder arrangements, Rudder fittings- Rudder pintle - Rudder types- Balanced rudder, semi balanced rudder, Spade rudder, merits and demerits of various types of rudders, Propeller and rudder interaction, Rudder stopper, movement of rudders, Basic construction of Rudder

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon successful completion of the course, students should be able to:
CO1: Explain the basics of propulsion system and ship dynamic movements
CO2: Familiarize with various components assisting ship stabilization.
CO3: Demonstrate the performance of the ship.
CO4: Classify the Propeller and its types, Materials etc.
CO5: Categories the Rudder and its types, design criteria of rudder.

TEXT BOOKS:
1. GP. Ghose, “Basic Ship propulsion”, 2015

REFERENCES BOOKS:

MAPPING OF COS AND POS:

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>O1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Avg</td>
<td>5/5</td>
<td>2/2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>P O</th>
<th>P O</th>
<th>P O</th>
<th>P O</th>
<th>P O</th>
<th>P O</th>
<th>P O</th>
<th>P O</th>
<th>P O</th>
<th>P O</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Avg</td>
<td>5/5</td>
<td>2/2</td>
<td>4/4</td>
<td>4/4</td>
<td>2/2</td>
<td>1/1</td>
<td>1/1</td>
<td>1/1</td>
<td>2/2</td>
<td>1/1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>PS O</th>
<th>PS O</th>
<th>PS O</th>
<th>PS O</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

311
OBJECTIVES:
At the end of the course, students are expected to acquire
1. Knowledge on basics of Hydrostatics
2. Familiarization on types of merchant ships
3. Knowledge on Shipbuilding Materials
4. Knowledge on marine propeller and rudder
5. Awareness on governing bodies in shipping industry

UNIT I  INTRODUCTION TO HYDROSTATICS  9
Archimedes Principle- Laws of floatation– Meta centre – stability of floating and submerged bodies-
Density, relative density - Displacement –Pressure –centre of pressure.

UNIT II  TYPES OF SHIP  10
General cargo ship - Refrigerated cargo ships - Container ships - Roll-on Roll-off ships – Oil tankers-
Bulk carriers - Liquefied Natural Gas carriers - Liquefied Petroleum Gas carriers - Chemical tankers -
Passenger ships

UNIT III  SHIPBUILDING MATERIALS  9
Types of Steels used in Shipbuilding - High tensile steels, Corrosion resistant steels, Steel
sandwich panels, Steel castings, Steel forgings - Other shipbuilding materials, Aluminium alloys,
Aluminium alloy sandwich panels, Fire protection especially for Aluminium Alloys, Fiber Reinforced
Composites

UNIT IV  MARINE PROPELLER AND RUDDER  8
Types of rudder, construction of Rudder-Types of Propeller, Propeller material-Cavitations and its
effects on propeller

UNIT V  GOVERNING BODIES FOR SHIPPING INDUSTRY  9
Role of IMO (International Maritime Organization), SOLAS (International Convention for the Safety
of Life at Sea), MARPOL (International Convention for the Prevention of Pollution from Ships ),
MLC (Maritime Labour Convention), STCW 2010 (International Convention on Standards of
Training, Certification and Watch keeping for Seafarers), Classification societies Administration
authorities

OUTCOMES:
Upon completion of this course, students would
1. Acquire Knowledge on floatation of ships
2. Acquire Knowledge on features of various ships
3. Acquire Knowledge of Shipbuilding Materials
4. Acquire Knowledge to identify the different types of marine propeller and rudder
5. Understand the Roles and responsibilities of governing bodies

TEXT BOOKS:
2. Dr.DA Taylor, “Merchant Ship Naval Architecture” I. Mar EST publications, 2006

REFERENCES:
2. MARPOL Consolidated Edition , Bhandakar Publications, 2018
OBJECTIVES:
At the end of the course, students are expected to
1. Understand the role of Marine machinery systems
2. Be familiar with Marine propulsion machinery system
3. Acquaint with Marine Auxiliary machinery system
4. Have acquired basics of Marine Auxiliary boiler system
5. Be aware of ship propellers and steering system

UNIT I ELEMENTARY KNOWLEDGE ON MARINE MACHINERY SYSTEMS
Marine Engineering Terminologies, Parts of Ship, Introduction to Machinery systems on board ships – Propulsion Machinery system, Electricity Generator system, Steering gear system, Air compressors & Air reservoirs, Fuel oil and Lubricating Oil Purifiers, Marine Boiler systems

UNIT II MARINE PROPULSION MACHINERY SYSTEM
Two stroke Large Marine slow speed Diesel Engine – General Construction, Basic knowledge of Air starting and reversing mechanism, Cylinder lubrication oil system, Main lubricating oil system and cooling water system

UNIT III MARINE AUXILIARY MACHINERY SYSTEM
Four stroke medium speed Diesel engine – General Construction, Inline, V-type arrangement of engine, Difference between slow speed and medium speed engines – advantages, limitations and applications

UNIT IV MARINE BOILER SYSTEM
Types of Boiler – Difference between Water tube boiler and Fire tube boiler, Need for boiler on board ships, Uses of steam, Advantages of using steam as working medium, Boiler mountings and accessories – importance of mountings, need for accessories

UNIT V SHIP PROPELLERS AND STEERING MECHANISM
Importance of Propellor and Steering gear, Types of propellers - Fixed pitch propellers, Controllable pitch propellers, Water jet propellers, Steering gear systems - 2-Ram and 4 Ram steering gear, Electric steering gear

OUTCOMES:
At the end of the course, students should able to,
1. Distinguish the role of various marine machinery systems
2. Relate the components of marine propulsion machinery system
3. Explain the importance of marine auxiliary machinery system
4. Acquire knowledge of marine boiler system
5. Understand the importance of ship propellers and steering system

TEXT BOOKS:
REFERENCES:
1. Alan L. Rowen, “Introduction to Practical Marine Engineering, Volume 1&2, The Institute of Marine Engineers (India), Mumbai, 2006
2. A.S. Tambwekar, “Naval Architecture and Ship Construction”, The Institute of Marine Engineers (India), Mumbai, 2015

COURSE OBJECTIVES:
1. To understand the basics of drone concepts
2. To learn and understand the fundamentals of design, fabrication, and programming of drone
3. To impart the knowledge of an flying and operation of drone
4. To know about the various applications of drone
5. To understand the safety risks and guidelines of fly safely

UNIT I  INTRODUCTION TO DRONE TECHNOLOGY  9
Drone Concept - Vocabulary Terminology - History of drone - Types of current generation of drones based on their method of propulsion - Drone technology impact on the businesses - Drone business through entrepreneurship - Opportunities/applications for entrepreneurship and employability

UNIT II  DRONE DESIGN, FABRICATION AND PROGRAMMING  9
Classifications of the UAV - Overview of the main drone parts - Technical characteristics of the parts - Function of the component parts - Assembling a drone - The energy sources - Level of autonomy - Drones configurations - The methods of programming drone - Download program - Install program on computer - Running Programs - Multi rotor stabilization - Flight modes - Wi-Fi connection.

UNIT III  DRONE FLYING AND OPERATION  9
Concept of operation for drone - Flight modes - Operate a small drone in a controlled environment - Drone controls Flight operations - management tool - Sensors - Onboard storage capacity - Removable storage devices - Linked mobile devices and applications

UNIT IV  DRONE COMMERCIAL APPLICATIONS  9
Choosing a drone based on the application - Drones in the insurance sector - Drones in delivering mail, parcels and other cargo - Drones in agriculture - Drones in inspection of transmission lines and power distribution - Drones in filming and panoramic picturing

UNIT V  FUTURE DRONES AND SAFETY  9
The safety risks - Guidelines to fly safely - Specific aviation regulation and standardization - Drone license - Miniaturization of drones - Increasing autonomy of drones - The use of drones in swarms

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon successful completion of the course, students should be able to:
CO1: Know about a various type of drone technology, drone fabrication and programming.
CO2: Execute the suitable operating procedures for functioning a drone
CO3: Select appropriate sensors and actuators for Drones
CO4: Develop a drone mechanism for specific applications
CO4: Create the programs for various drones

CO-PO MAPPING:

<table>
<thead>
<tr>
<th>COs/Pos&amp;PSOs</th>
<th>POs</th>
<th>PSOs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO/PO &amp; PSO</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Average</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

1 – Slight, 2 – Moderate, 3 – Substantial

TEXT BOOKS

REFERENCES

OGI352 GEOGRAPHICAL INFORMATION SYSTEM L T P C
3 0 0 3

OBJECTIVES:
To impart the knowledge on basic components, data preparation and implementation of Geographical Information System.

UNIT I FUNDAMENTALS OF GIS
9

UNIT II SPATIAL DATA MODELS
9
UNIT III  DATA INPUT AND TOPOLOGY  9

UNIT IV  DATA QUALITY AND STANDARDS  9
Data quality - Basic aspects - completeness, logical consistency, positional accuracy, temporal accuracy, thematic accuracy and lineage – Metadata – GIS Standards –Interoperability - OGC - Spatial Data Infrastructure

UNIT V  DATA MANAGEMENT AND OUTPUT  9
Import/Export – Data Management functions- Raster to Vector and Vector to Raster Conversion - Data Output - Map Compilation – Chart/Graphs – Multimedia – Enterprise Vs. Desktop GIS- distributed GIS.

TOTAL:45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student is expected to
CO1 Have basic idea about the fundamentals of GIS.
CO2 Understand the types of data models.
CO3 Get knowledge about data input and topology
CO4 Gain knowledge on data quality and standards
CO5 Understand data management functions and data output

TEXT BOOKS:

REFERENCES:

CO – PO – PSO MAPPING: GEOGRAPHIC INFORMATION SYSTEM

<table>
<thead>
<tr>
<th>PO</th>
<th>Graduate Attribute</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>Engineering Knowledge</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO2</td>
<td>Problem Analysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO3</td>
<td>Design/Development of Solutions</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO4</td>
<td>Conduct Investigations of Complex Problems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO5</td>
<td>Modern Tool Usage</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>PO6</td>
<td>The Engineer and Society</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO 7</td>
<td>Environment and Sustainability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO 8</td>
<td>Ethics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO 9</td>
<td>Individual and Team Work</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO10</td>
<td>Communication</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO11</td>
<td>Project Management and Finance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO12</td>
<td>Life-long Learning</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PSO1</td>
<td>Knowledge of Geoinformatics</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To introduce the importance of Agri-business management, its characteristics and principles
- To impart knowledge on the functional areas of Agri-business like Marketing management, Product pricing methods and Market potential assessment.

UNIT I ENTREPRENEURIAL ENVIRONMENT IN INDIAN CONTEXT

Entrepreneur Development (ED): Concept of entrepreneur and entrepreneurship assessing overall business environment in Indian economy- Entrepreneurial and managerial characteristics- Entrepreneurship development programmes (EDP)- Generation incubation and commercialization of ideas and innovations- Motivation and entrepreneurship development- Globalization and the emerging business entrepreneurial environment.

UNIT II AGRIPRNEURSHIP IN GLOBAL ARENA: LEGAL PERSPECTIVE

Importance of agribusiness in Indian economy - International trade-WTO agreements- Provisions related to agreements in agricultural and food commodities - Agreements on Agriculture (AOA)- Domestic supply, market access, export subsidies agreements on sanitary and phyto-sanitary (SPS) measures, Trade related intellectual property rights (TRIPS).

UNIT III ENTREPRENEURSHIP MANAGEMENT: FINANCIAL PERSPECTIVE


UNIT IV ENTREPRENEURIAL OPPORTUNITIES: ECONOMIC GROWTH PERSPECTIVE

Managing an enterprise: Importance of planning, budgeting, monitoring evaluation and follow-up managing competition. Role of ED in economic development of a country- Overview of Indian social, political system and their implications for decision making by individual entrepreneurs- Economic system and its implication for decision making by individual entrepreneurs.

UNIT V ENTREPRENEURIAL PROMOTION MEASURES AND GOVERNMENT SUPPORT
Social responsibility of business. Morals and ethics in enterprise management- SWOT analysis-
Government schemes and incentives for promotions of entrepreneurship. Government policy on
small and medium enterprises (SMEs)/SSIs/MSME sectors- Venture capital (VC), contract
framing (CF) and Joint Venture (JV), public-private
partnerships (PPP) - overview of agricultural engineering industry, characteristics of Indian farm
machinery industry.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
1. Judge about agricultural finance, banking and cooperation
2. Evaluate basic concepts, principles and functions of financial management
3. Improve the skills on basic banking and insurance schemes available to customers
4. Analyze various financial data for efficient farm management
5. Identify the financial institutions

TEXT BOOKS:
Delhi

REFERENCES:
Hall Inc, New Jersey
3. Gittenger Price, 1989, Economic Analysis of Agricultural project, John Hopkins University,
Press, London.
Jersey.
Saddal Rover, New Jersey.
CO-PO MAPPING

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
<th>Overall correlation of COs with POs</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1 Engineering Knowledge</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>PO2 Problem Analysis</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>PO3 Design/ Development of Solutions</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>PO4 Conduct Investigations of Complex Problems</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO5 Modern Tool Usage</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>PO6 The Engineer and Society</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO7 Environment and sustainability</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO8 Ethics</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>PO9 Individual and team work:</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO10 Communication</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO11 Project management and finance</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO12 Life-long learning:</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>PSO1 To make expertise in design and engineering problem solving approach in agriculture with proper knowledge and skill</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PSO2 To enhance students ability to formulate solutions to real-world problems pertaining to sustained agricultural productivity using modern technologies.</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PSO3 To inculcate entrepreneurial skills through strong Industry-Institution linkage.</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

OEN352 BIODIVERSITY CONSERVATION

OBJECTIVE:
The identification of different aspects of biological diversity and conservation techniques.

UNIT I INTRODUCTION
Concept of Species, Variation; Introduction to Major Plant Groups; Evolutionary relationships between Plant Groups; Nomenclature and History of plant taxonomy; Systems of Classification and their Application; Study of Plant Groups; Study of Identification Characters; Study of important families of Angiosperms; Plant Diversity Application.

UNIT II INTRODUCTION TO ANIMAL DIVERSITY AND TAXONOMY
Principles and Rules of Taxonomy; ICZN Rules, Animal Study Techniques; Concepts of Taxon, Categories, Holotype, Paratype, Topotype etc; Classification of Animal kingdom, Invertebrates, Vertebrates, Evolutionary relationships between Animal Groups.

319
UNIT III MICROBIAL DIVERSITY 9
Microbes and Earth History, Magnitude, Occurrence and Distribution. Concept of Species, Criteria for Classification, Outline Classification of Microorganisms (Bacteria, Viruses and Protozoa); Criteria for Classification and Identification of Fungi; Chemical and Biochemical Methods of Microbial Diversity Analysis

UNIT IV MEGA DIVERSITY 9
Biodiversity Hot-spots, Floristic and Faunal Regions in India and World; IUCN Red List; Factors affecting Diversity, Impact of Exotic Species and Human Disturbance on Diversity, Dispersal, Diversity-Stability Relationship; Socio- economic Issues of Biodiversity; Sustainable Utilization of Bioresources; National Movements and International Convention/Treaties on Biodiversity.

UNIT V CONSERVATIONS OF BIODIVERSITY 9
In-Situ Conservation- National parks, Wildlife sanctuaries, Biosphere reserves; Ex-situ conservation- Gene bank, Cryopreservation, Tissue culture bank; Long term captive breeding, Botanical gardens, Animal Translocation, Zoological Gardens; Concept of Keystone Species, Endangered Species, Threatened Species, Rare Species, Extinct Species

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:

OUTCOMES:
Upon successful completion of this course, students will:
CO1: An insight into the structure and function of diversity for ecosystem stability.
CO2: Understand the concept of animal diversity and taxonomy
CO3: Understand socio-economic issues pertaining to biodiversity
CO4: An understanding of biodiversity in community resource management.
CO5: Student can apply fundamental knowledge of biodiversity conservation to solve problems associated with infrastructure development.

CO’s- PO’s & PSO’s MAPPING

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

1. low, 2-medium, 3-high, '*'- no correlation

Note: The average value of this course to be used for program articulation matrix.
OBJECTIVES
- To impart knowledge on various representations of systems.
- To familiarize time response analysis of LTI systems and steady state error.
- To analyze the frequency responses and stability of the systems
- To analyze the stability of linear systems in frequency domain and time domain
- To develop linear models mainly state variable model and transfer function model

UNIT I MATHEMATICAL MODELS OF PHYSICAL SYSTEMS 9
Definition & classification of system – terminology & structure of feedback control theory – Analogous systems - Physical system representation by Differential equations – Block diagram reduction–Signal flow graphs.

UNIT II TIME RESPONSE ANALYSIS & ROOTLOCUS TECHNIQUE 9

UNIT III FREQUENCY RESPONSE ANALYSIS 9
Correlation between Time & Frequency response – Polar plots – Bode Plots – Determination of Transfer Function from Bode plot.

UNIT IV STABILITY CONCEPTS & ANALYSIS 9

UNITY V STATE VARIABLE ANALYSIS 9
Concept of state – State Variable & State Model – State models for linear & continuous time systems–Solution of state & output equation–controllability & observability.

OUTCOMES:
Ability to
CO1: Design the basic mathematical model of physical System.
CO2: Analyze the time response analysis and techniques.
CO3: Analyze the transfer function from different plots.
CO4: Apply the stability concept in various criterion.
CO5: Assess the state models for linear and continuous Systems.

TEXTBOOKS:

REFERENCES:
2. Control System Dynamics” by Robert Clark, Cambridge University Press, 1996 USA.
INTRODUCTION TO INDUSTRIAL AUTOMATION SYSTEMS

COURSE OBJECTIVES:
1. To educate on design of signal conditioning circuits for various applications.
2. To introduce signal transmission techniques and their design.
3. Study of components used in data acquisition systems interface techniques
4. To educate on the components used in distributed control systems
5. To introduce the communication buses used in automation industries.

UNIT I  INTRODUCTION

UNIT II  AUTOMATION COMPONENTS
Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

UNIT III  COMPUTER AIDED MEASUREMENT AND CONTROL SYSTEMS
Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking. Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation.

UNIT IV  PROGRAMMABLE LOGIC CONTROLLERS
Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

UNIT V  DISTRIBUTED CONTROL SYSTEM
Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

TOTAL:45 PERIODS

SKILL DEVELOPMENT ACTIVITIES (Group Seminar/Mini Project/Assignment/Content Preparation / Quiz/ Surprise Test / Solving GATE questions/ etc)
1. Market survey of the recent PLCs and comparison of their features.
2. Summarize the PLC standards
3. Familiarization of any one programming language (Ladder diagram/ Sequential Function Chart/ Function Block Diagram/ Equivalent open source software)
COURSE OUTCOMES:
Students able to
CO1 Design a signal conditioning circuits for various application (L3).
CO2 Acquire a detail knowledge on data acquisition system interface and DCS system (L2).
CO3 Understand the basics and Importance of communication buses in applied automation Engineering (L2).
CO4 Ability to design PLC Programmes by Applying Timer/Counter and Arithmetic and Logic Instructions Studied for Ladder Logic and Function Block.(L3)
CO5 Able to develop a PLC logic for a specific application on real world problem. (L5)

TEXT BOOKS:

REFERENCES:

List of Open Source Software/ Learning website:
1. https://archive.nptel.ac.in/courses/108/105/108105062/
2. https://nptel.ac.in/courses/108105063

<table>
<thead>
<tr>
<th>CO’s- PO’s &amp; PSO’s MAPPING</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1 3 2 2 2 1 1 1 1 1 1 1 1</td>
</tr>
<tr>
<td>CO2 3 1 1 1 1 1 1 1 1 1 1 1</td>
</tr>
<tr>
<td>CO3 3 1 1 1 1 1 1 1 1 1 1 1</td>
</tr>
<tr>
<td>CO4 3 3 3 3 1 1 1 1 1 1 1 1</td>
</tr>
<tr>
<td>CO5 3 3 3 3 1 1 1 1 1 1 1 1</td>
</tr>
<tr>
<td>Avg. 3 2.25 2.6 1 1 1 1 1 1 1 1 1</td>
</tr>
</tbody>
</table>

OCH353 ENERGY TECHNOLOGY L T P C 3 0 0 3

UNIT I INTRODUCTION
Units of energy, conversion factors, general classification of energy, world energy resources and energy consumption, Indian energy resources and energy consumption, energy crisis, energy alternatives, Renewable and non-renewable energy sources and their availability. Prospects of Renewable energy sources
UNIT II  CONVENTIONAL ENERGY  8
Conventional energy resources, Thermal, hydel and nuclear reactors, thermal, hydel and nuclear power plants, efficiency, merits and demerits of the above power plants, combustion processes, fluidized bed combustion.

UNIT III  NON-CONVENTIONAL ENERGY  10
Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation, solar energy application in India, energy plantations. Wind energy, types of windmills, types of wind rotors, Darrieus rotor and Gravian rotor, wind electric power generation, wind power in India, economics of wind farm, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

UNIT IV  BIOMASS ENERGY  10
Biomass energy resources, thermo-chemical and biochemical methods of biomass conversion, combustion, gasification, pyrolysis, biogas production, ethanol, fuel cells, alkaline fuel cell, phosphoric acid fuel cell, molten carbonate fuel cell, solid oxide fuel cell, solid polymer electrolyte fuel cell, magneto hydrodynamic power generation, energy storage routes like thermal energy storage, chemical, mechanical storage and electrical storage.

UNIT V  ENERGY CONSERVATION  9
Energy conservation in chemical process plants, energy audit, energy saving in heat exchangers, distillation columns, dryers, ovens and furnaces and boilers, steam economy in chemical plants, energy conservation.

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the students will be able to
CO1: Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil fuels.
CO2: Students will excel as professionals in the various fields of energy engineering
CO3: Compare different renewable energy technologies and choose the most appropriate based on local conditions.
CO4: Explain the technological basis for harnessing renewable energy sources.
CO5: Identify and critically evaluate current developments and emerging trends within the field of renewable energy technologies and to develop in-depth technical understanding of energy problems at an advanced level.

TEXT BOOKS:

REFERENCES

Course articulation matrix

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>Program Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statements</td>
<td>PO1</td>
</tr>
<tr>
<td>------------</td>
<td>-----</td>
</tr>
<tr>
<td>CO1</td>
<td>2</td>
</tr>
<tr>
<td>Students will be able to describe the fundamentals and main characteristics of renewable energy sources and their differences compared to fossil</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
</tr>
<tr>
<td>Students will excel as professionals in the fields of energy engineering</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
</tr>
<tr>
<td>Compare different energy technologies and choose the most appropriate based on local conditions</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
</tr>
<tr>
<td>Explain the technological basis for harnessing renewable energy</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
</tr>
<tr>
<td>Identify and critically evaluate current developments and trends within the field of renewable energy technologies and to in-depth technical understanding of energy problems at an advanced level</td>
<td>2</td>
</tr>
<tr>
<td>OVERALL CO</td>
<td>2</td>
</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively

OCH354 SURFACE SCIENCE

OBJECTIVE:
- To enable the students to analyze properties of surfaces and correlate them to structure, chemistry, and physics and surface modification technique.

UNIT I SURFACE STRUCTURE AND EXPERIMENTAL PROBES
Relevance of surface science to Chemical and Electrochemical Engineering, Heterogeneous Catalysis and Nanoscience; Surface structure and reconstructions, absorbate structure, Band and Vibrational structure, Importance of UHV techniques, Electronic probes and molecular beams, Scanning probes and diffraction, Qualitative introduction to electronic and vibrational spectroscopy

UNIT II ADSORPTION, DYNAMICS, THERMODYNAMICS AND KINETICS AT SURFACES

325
Interactions at the surface, Physisorption, Chemisorption, Diffusion, dynamics and reactions of atoms/molecules on surfaces, Generic reaction mechanism on surfaces, Adsorption isotherms, Kinetics of adsorption, Use of temperature desorption methods

UNIT III LIQUID INTERFACES 9
Structure and Thermodynamics of liquid-solid interface, Self-assembled monolayers, Electrified interfaces, Charge transfer at the liquid-solid interfaces, Photoelectrochemical processes, Gratzel cells

UNIT IV HETEROGENEOUS CATALYSIS 9
Characterization of heterogeneous catalytic processes, Microscopic kinetics to catalysis, Overview of important heterogeneous catalytic processes: Haber-Bosch, Fishcher-Tropsch and Automotive catalysis, Role of promoters and poisons, Bimetallic surfaces, surface functionalization and clusters in catalysis, Role of Sabatier principle in catalyst design, Rate oscillations and spatiotemporal pattern formation

UNIT V EPITAXIAL GROWTH AND NANO SURFACE-_STRUCTURES 9

TOTAL: 45 PERIODS

OUTCOME:
• Upon completion of this course, the students can understand, predict and design surface properties based on surface structure. Students would understand the physics and chemistry behind surface phenomena

TEXT BOOK:

REFERENCE:

OFD354 FUNDAMENTALS OF FOOD ENGINEERING L T P C 3 0 0 3

OBJECTIVES:
The course aims to
• Acquaint and equip the students with different techniques of measurement of engineering properties.
• Make the students understand the nature of food constituents in the design of processing equipment

UNIT I 9
Engineering properties of food materials: physical, thermal, aerodynamic, mechanical, optical and electromagnetic properties.
UNIT II
Drying and dehydration: Basic drying theory, heat and mass transfer in drying, drying rate curves, calculation of drying times, dryer efficiencies; classification and selection of dryers; tray, vacuum, osmotic, fluidized bed, pneumatic, rotary, tunnel, trough, bin, belt, microwave, IR, heat pump and freeze dryers; dryers for liquid: Drum or roller dryer, spray dryer and foammat dryers

UNIT III
Size reduction: Benefits, classification, determination and designation of the fineness of ground material, sieve/screen analysis, principle and mechanisms of comminution of food, Rittinger’s, Kick’s and Bond’s equations, work index, energy utilization; Size reduction equipment: Principal types, crushers (jaw crushers, gyratory, smooth roll), hammer mills and impactors, attrition mills, buhr mill, tumbling mills, tumbling mills, ultra fine grinders, fluid jet pulverizer, colloid mill, cutting machines (slicing, dicing, shredding, pulping)

UNIT IV
Mixing: theory of solids mixing, criteria of mixer effectiveness and mixing indices, rate of mixing, theory of liquid mixing, power requirement for liquids mixing; Mixing equipment: Mixers for low- or medium-viscosity liquids (paddle agitators, impeller agitators, powder-liquid contacting devices, other mixers), mixers for high viscosity liquids and pastes, mixers for dry powders and particulate solids.

UNIT V
Mechanical Separations: Theory, centrifugation, liquid-liquid centrifugation, liquid-solid centrifugation, clarifiers, desludging and decanting machine. Filtration: Theory of filtration, rate of filtration, pressure drop during filtration, applications, constant-rate filtration and constant-pressure filtration, derivation of equation; Filtration equipment: plate and frame filter press, rotary filters, centrifugal filters and air filters, filter aids, Membrane separation: General considerations, materials for membrane construction, ultrafiltration, microfiltration, concentration, polarization, processing variables, membrane fouling, applications of ultra-filtration in food processing, reverse osmosis, mode of operation, and applications; Membrane separation methods, demineralization by electro-dialysis, gel filtration, ion exchange, per-evaporation and osmotic dehydration.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course the students will be able to
CO1 understand the importance of food polymers
CO2 understand the effect of various methods of processing on the structure and texture of food materials
CO3 understand the interaction of food constituents with respect to thermal, electrical properties to develop new technologies for processing and preservation.

TEXT BOOKS:
OBJECTIVES:
• To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments
• To help become skilled in systems for food safety surveillance
• To be aware of the regulatory and statutory bodies in India and the world
• To ensure processed food meets global standards

UNIT I
Introduction to food safety and security: Hygienic design of food plants and equipments, Food Contaminants (Microbial, Chemical, Physical), Food Adulteration (Common adulterants), Food Additives (functional role, safety issues), Food Packaging & labeling. Sanitation in warehousing, storage, shipping, receiving, containers and packaging materials. Control of rats, rodents, mice, birds, insects and microbes. Cleaning and Disinfection, ISO 22000 – Importance and Implementation

UNIT II
Food quality: Various Quality attributes of food, Instrumental, chemical and microbial Quality control. Sensory evaluation of food and statistical analysis. Water quality and other utilities.

UNIT III
Critical Quality control point in different stages of production including raw materials and processing materials. Food Quality and Quality control including the HACCP system. Food inspection and Food Law, Risk assessment – microbial risk assessment, dose response and exposure response modelling, risk management, implementation of food surveillance system to monitor food safety, risk communication

UNIT IV
Indian and global regulations: FAO in India, Technical Cooperation programmes, Bio-security in Food and Agriculture, World Health Organization (WHO), World Animal Health Organization (OIE), International Plant Protection Convention (IPPC)

UNIT V
Codex Alimentarius Commission - Codex India – Role of Codex Contact point, National Codex contact point (NCCP), National Codex Committee of India – ToR, Functions, Shadow Committees etc.

COURSE OUTCOMES:
CO1 Thorough Knowledge of food hazards, physical, chemical and biological in the industry and food service establishments
CO2 Awareness on regulatory and statutory bodies in India and the world

REFERENCES:
1. Handbook of food toxicology by S. S. Deshpande, 2002
2. The food safety information handbook by Cynthia A. Robert, 2009
4. Microbiological safety of Food by Hobbs BC, 1973
OBJECTIVES:
- To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction.
- To understand the role of Nutraceuticals and functional food in health and disease.

UNIT I INTRODUCTION AND SIGNIFICANCE
Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoochemicals and microbes in food, plants, animals and microbes.

UNIT II PHYTOCHEMICALS AS NUTRACEUTICALS
Phytoestrogens in plants; isoflavones; flavonols, polyphenols, tannins, saponins, lignans, lycopene, chitin, carotenoids. Manufacturing practice of selected nutraceuticals such as lycopene, isoflavonoids, glucosamine, phytosterols. Formulation of functional foods containing nutraceuticals - stability, analytical and labelling issues.

UNIT III ASSESSMENT OF ANTIOXIDANT ACTIVITY
In vitro and in vivo methods for the assessment of antioxidant activity, Comparison of different in vitro methods to evaluate the antioxidant, antioxidant mechanism, Prediction of the antioxidant activity of natural phenolics from electrotropological state indices, Optimising phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources.

UNIT IV ROLE IN HEALTH AND DISEASE
The health benefit of - Soy protein, Spirulina, Tea, Olive oil, plant sterols, Broccoli, omega3 fatty acid and eicosanoids. Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and synbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.

UNIT V SAFETY ISSUES
Health Claims, Adverse effects and toxicity of nutraceuticals, regulations and safety issues International and national.

TOTAL: 45 PERIODS

TEXT BOOKS:
3. WEBB, PP, Dietary Supplements and Functional Foods Blackwell Publishing Ltd (United Kingdom), 2006

REFERENCES:
1. Asian Functional Foods (Nutraceutical Science and Technology) by John Shi (Editor), Fereidoon Shahidi (Editor), Chi-Tang Ho (Editor), CRC Publications, Taylor & Francis, 2007

6. COURSE OUTCOME - NUTRACEUTICALS

- Acquire knowledge about the nutraceuticals and functional foods, their classification and benefits.
- Acquire knowledge of phytochemicals, zoochemicals and microbes in food, plants, and microbes.
- Attain the knowledge of the manufacturing practices of selected nutraceutical components and formulation considerations of functional foods.
- Distinguish the various in vitro and in vivo assessment of antioxidant activity of compounds from plant sources.
- Gain information about the health benefits of various functional foods and nutraceuticals in prevention and treatment of various lifestyle diseases.
- Attain the knowledge of the regulatory and safety issues of nutraceuticals at national and international level.

<table>
<thead>
<tr>
<th>CO – PO MAPPING</th>
<th>NUTRACEUTICALS</th>
</tr>
</thead>
<tbody>
<tr>
<td>COURSE OUTCOME</td>
<td>PO1</td>
</tr>
<tr>
<td>CO 1</td>
<td>3</td>
</tr>
<tr>
<td>CO 2</td>
<td>3</td>
</tr>
<tr>
<td>CO 3</td>
<td>3</td>
</tr>
<tr>
<td>CO 4</td>
<td>3</td>
</tr>
<tr>
<td>CO 5</td>
<td>3</td>
</tr>
<tr>
<td>CO 6</td>
<td>3</td>
</tr>
</tbody>
</table>

OTT354 BASICS OF DYEING AND PRINTING 3 0 0 3

OBJECTIVE:
- To enable the students to learn about the basics of Pretreatment, dyeing, printing and machinery in textile processing.

UNIT I INTRODUCTION 9
Impurities present in different fibres, Inspection of grey goods and lot preparation. Shearing,

UNIT II PRE TREATMENT 9
mechanism of Hydrogen Peroxide, Hypo chlorites. Objective of Mercerizing - Physical and Chemical changes of Mercerizing.

UNIT III DYEING

UNIT IV PRINTING
Definition of printing – Difference between printing and dyeing- Classification thickeners – Requirements to be good thickener, printing paste Preparation - different styles of printing.

UNIT V MACHINERIES

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, the students will be able to Understand the
CO1: Basics of grey fabric
CO2: Basics of pre treatment
CO3: Concept of Dyeing
CO4: Concept of Printing
CO5: Machinery in processing industry

TEXT BOOKS:

REFERENCES:
2. Dr. N N Mahapatra., “Textile dyeing”, Wood head publishing India, 2018
4. Bleaching & Mercerizing – BTRA Silver Jubilee Monograph series

COURSE ARTICULATION MATRIX:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Program Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Statement</td>
</tr>
<tr>
<td>CO1</td>
<td>Classification of fibres and production of natural fibres</td>
</tr>
<tr>
<td>CO2</td>
<td>Regenerated and synthetic fibres</td>
</tr>
<tr>
<td>CO3</td>
<td>Yarn spinning</td>
</tr>
<tr>
<td>CO4</td>
<td>Weaving</td>
</tr>
<tr>
<td>CO5</td>
<td>Knitting and</td>
</tr>
</tbody>
</table>

1, 2 and 3 are correlation levels with weightings as Slight (Low), Moderate (Medium) and Substantial (High) respectively
FT 3201

FIBRE SCIENCE

L T P C
3 0 0 3

COURSE OBJECTIVES
- To enable the students to learn about the types of fibre and its properties

UNIT I
INTRODUCTION TO TEXTILE FIBRES
Definition of various forms of textile fibres - staple fibre, filament, bicomponent fibres. Classification of Natural and Man-made fibres, essential and desirable properties of Fibres. Production and cultivation of Natural Fibers: Cotton, Silk, Wool -Physical and chemical structure of the above fibres.

UNIT II
REGENERATED FIBRES
Production Sequence of Regenerated Cellulosic fibres: Viscose Rayon, Acetate rayon – High wet modulus fibres: Modal and Lyocel ,Tencel

UNIT III
SYNTHETIC FIBRES
Production Sequence of Synthetic Fibers: polymer-Polyester, Nylon, Acrylic and polypropylene. Mineral fibres: fibre glass ,carbon .Introduction to spin finishes and texturization

UNIT IV
SPECIALITY FIBRES
Properties and end uses of high tenacity and high modulus fibres, high temperature and flame retardant fibres, Chemical resistant fibres

UNIT V
FUNCTIONAL SPECIALITY FIBRES
Properties and end uses : Fibres for medical application – Biodegradable fibres based on PLA ,Super absorbent fibres elastomeric fibres, ultra-fine fibres, electrospun nano fibres, metallic fibres – Gold and Silver coated.

COURSE OUTCOMES
Upon completion of this course, the student would be able to
- Understand the process sequence of various fibres
- Understand the properties of various fibres

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
OBJECTIVE:
- To enable the students to understand the basics of pattern making, cutting and sewing.
- To expose the students to various problems & remedies during garment manufacturing

UNIT I  PATTERN MAKING, MARKER PLANNING, CUTTING
- Anthropometry, specification sheet, pattern making – principles, basic pattern set drafting, grading, marker planning, spreading & cutting

UNIT II  TYPES OF SEAMS, STITCHES AND FUNCTIONS OF NEEDLES
- Different types of seams and stitches; single needle lock stitch machine – mechanism and accessories; needle – functions, special needles, needlepoint

UNIT III  COMPONENTS AND TRIMS USED IN GARMENT
- Sewing thread-construction, material, thread size, packages, accessories – labels, linings, interlinings, wadding, lace, braid, elastic, hook and loop fastening, shoulder pads, eyelets and laces, zip fasteners, buttons

UNIT IV  GARMENT INSPECTION AND DIMENSIONAL CHANGES
- Raw material, in process and final inspection; needle cutting; sewability of fabrics; strength properties of apparel; dimensional changes in apparel due to laundering, dry-cleaning, steaming and pressing.

UNIT V  GARMENT PRESSING, PACKING AND CARE LABELING
- Garment pressing – categories and equipment, packing; care abelling of apparels

OUTCOMES:
Upon completion of the course, the students will be able to understand
CO1: Pattern making, marker planning, cutting
CO2: Types of seams, stitches and functions of needles
CO3: Components and trims used in garment
CO4: Garment inspection and dimensional changes
CO5: Garment pressing, packing and care abelling

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Avg</td>
<td>1.6</td>
<td>1.2</td>
</tr>
</tbody>
</table>

OPE353 INDUSTRIAL SAFETY

OBJECTIVES:
- To educate about the health hazards and the safety measures to be followed in the industrial environment.
- Describe industrial legislations (Factories Acts, Workmen's Compensation and other laws) enacted for the protection of employees health at work settings
- Describe methods of prevention and control of Occupational Health diseases, accidents / emergencies and other hazards

UNIT I INTRODUCTION
Need for developing Environment, Health and Safety systems in work places - Accident Case Studies - Status and relationship of Acts - Regulations and Codes of Practice - Role of trade union safety representatives. International initiatives - Ergonomics and work place.

UNIT II OCCUPATIONAL HEALTH AND HYGIENE

UNIT III WORKPLACE SAFETY AND SAFETY SYSTEMS

UNIT IV HAZARDS AND RISK MANAGEMENT

UNIT V ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT

TOTAL: 45 PERIODS
OUTCOMES:
After completion of this course, the student is expected to be able to:

- Describe, with example, the common work-related diseases and accidents in occupational setting
- Name essential members of the Occupational Health team
- What roles can a community health practitioners play in an Occupational setting to ensure the protection, promotion and maintenance of the health of the employee

OPE354 UNIT OPERATIONS IN PETRO CHEMICAL INDUSTRIES L T P C

OBJECTIVES:
- To impart to the student basic knowledge on fluid mechanics, mechanical operations, heat transfer operations and mass transfer operations.

UNIT I FLUID MECHANICS CONCEPTS
Fluid definition and classification of fluids, types of fluids, Rheological behaviour of fluids & Newton’s Law of viscosity. Fluid statics-Pascal's law, Hydrostatic equilibrium, Barometric equation and pressure measurement(problems),Basic equations of fluid flow - Continuity equation, Euler’s equation and Bernoulli equation; Types of flow - laminar and turbulent; Reynolds experiment; Flow through circular and non-circular conduits - Hagen Poiseuille equation (no derivation). Flow through stagnant fluids – theory of Settling and Sedimentation – Equipment (cyclones, thickeners) Conceptual numericals.

UNIT II FLOW MEASUREMENTS & MECHANICAL OPERATIONS

UNIT III CONDUCTIVE & CONVECTIVE HEAT TRANSFER
Modes of heat transfer; Conduction – steady state heat conduction through unilayer and multilayer walls, cylinders; Insulation, critical thickness of insulation. Convection- Forced and Natural convection, principles of heat transfer co-efficient, log mean temperature difference, individual and overall heat transfer co-efficient, fouling factor; Condensation – film wise and drop wise (no derivation). Heat transfer equipments – double pipe heat exchanger, shell and tube heat exchanger (with working principle and construction with applications).

UNIT IV BASICS OF MASS TRANSFER

UNIT V MASS TRANSFER OPERATIONS
Basic concepts of Liquid-liquid extraction – equilibrium, stage type extractors (belt extraction and basket extraction). Distillation – Methods of distillation, distillation of binary mixtures using McCabe Thiele method. Drying- drying operations, batch and continuous drying. Conceptual numerical.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
At the end of the course the student will be able to:
- State and describe the nature and properties of the fluids.
- Study the different flow measuring instruments, the principles of various size reductions, conveying equipment’s, sedimentation and mixing tanks.
- Comprehend the laws governing the heat and mass transfer operations to solve the problems.
- Design the heat transfer equipment suitable for specific requirement.

TEXTBOOKS:
2. Fluid Mechanics K L Kumar S Chand & Company Ltd 2008

REFERENCE BOOKS
2. Unit Operations of Chemical Engineering, Vol I &II Chattopadhyaya Khanna Publishers, Delhi-6 1996

COURSE OBJECTIVES
- Understand the advantages, disadvantages and general classification of plastic materials
- To know the manufacturing, sources, and applications of engineering thermoplastics
- Understand the basics as well as the advanced applications of various plastic materials in the industry
- To understand the preparation methods of thermosetting materials
- Select suitable specialty plastics for different end applications

UNIT I INTRODUCTION TO PLASTIC MATERIALS
Introduction to Plastics – Brief history of plastics, advantages and disadvantages, thermoplastic and thermosetting behavior, amorphous polymers, crystalline polymers and cross-linked structures. General purpose thermoplastics/ Commodity plastics: manufacture, structure, properties and applications of polyethylene (PE), cross-linked PE, chlorinated PE, polypropylene, polyvinyl chloride-compounding, formulation, polypropylene (PP)

UNIT II ENGINEERING THERMOPLASTICS AND APPLICATIONS
Engineering thermoplastics – Aliphatic polyamides: structure, properties, manufacture and applications of Nylon 6, Nylon 66. Polyesters: manufacture, structure, properties and uses of PET, PBT. Manufacture, structure, properties and uses of Polycarbonates, acetal resins, polyimides, PMMA, polyphenylene oxide, thermoplastic polyurethane (PU)

UNIT III THERMOSETTING PLASTICS
Thermosetting Plastics – Manufacture, curing, moulding powder, laminates, properties and uses of phenol formaldehyde resins, urea formaldehyde, melamine formaldehyde, unsaturated polyester resin, epoxy resin, silicone resins, polyurethane resins.
UNIT IV  MISCELLANEOUS PLASTICS FOR END APPLICATIONS 9
Miscellaneous plastics- Manufacture, properties and uses of polystyrene, HIPS, ABS, SAN, poly(tetrafluoroethylene) (PTFE), TFE and copolymers, PVDF, PVA, poly (vinyl acetate), poly (vinyl carbazole), cellulose acetate, PEEK, High energy absorbing polymers, super absorbent polymers- their synthesis, properties and applications

UNIT V  PLASTICS MATERIALS FOR BIOMEDICAL APPLICATIONS 9
Sources, raw materials, methods of manufacturing, properties and applications of bio-based polymers-poly lactic acid (PLA), poly hydroxy alkanoates (PHA), PBAT, bioplastics- bio-PE, bio-PP, bio-PET, polymers for biomedical applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- To study the importance, advantages and classification of plastic materials
- Summarize the raw materials, sources, production, properties and applications of various engineering thermoplastics
- To understand the application of polyamides, polyesters and other engineering thermoplastics, thermosetting resins
- Know the manufacture, properties and uses of thermosetting resins based on polyester, epoxy, silicone and PU
- To understand the engineering applications of various polymers in miscellaneous areas and applications of different biopolymers

REFERENCES

OPT353  PROPERTIES AND TESTING OF PLASTICS  L T P C 3 0 0 3

COURSE OBJECTIVES
- To understand the relevance of standards and specifications as well as the specimen preparation for polymer testing.
- To study the mechanical properties and testing of polymer materials and their structural property relationships.
- To understand the thermal properties of polymers and their testing methods.
- To gain knowledge on the electrical and optical properties of polymers and their testing methods.
- To study about the environmental effects and prevent polymer degradation.

UNIT I  INTRODUCTION TO CHARACTERIZATION AND TESTING OF POLYMERS 9
UNIT II         MECHANICAL PROPERTIES 9
Mechanical properties: Tensile, compression, flexural, shear, tear strength, hardness, impact strength,
resilience, abrasion resistance, creep and stress relaxation, compression set, dynamic fatigue, ageing
properties, Basic concepts of stress and strain, short term tests: Viscoelastic behavior (simple models: Kelvin model for creep and stress relaxation, Maxwell-Voigt model, strain recovery and dynamic
response), Effect of structure and composition on mechanical properties, Behavior of reinforced
polymers.

UNIT III        THERMAL RHEOLOGICAL PROPERTIES 9
Thermal properties: Transition temperatures, specific heat, thermal conductivity, co-efficient of thermal
expansion, heat deflection temperature, Vicat softening point, shrinkage, brittleness temperature,
thermal stability and flammability. Product testing: Plastic films, sheeting, pipes, laminates, foams,
containers, cables and tubes.

UNIT IV        ELECTRICAL AND OPTICAL PROPERTIES 9
Electrical properties: volume and surface resistivity, dielectric strength, dielectric constant and power
dissipation factor, arc resistance, tracking resistance, dielectric behavior of polymers (dielectric co-efficient,
dielectric polarization), dissipation factor and its importance. Optical properties: transparency, refractive
index, haze, gloss, clarity, birefringence.

UNIT V        ENVIRONMENTAL AND CHEMICAL RESISTANCE 9
Environmental stress crack resistance (ESCR), water absorption, weathering, aging, ozone resistance,
permeability and adhesion. Tests for chemical resistance. Acids, alkalies, Flammability tests- oxygen
index test.

TOTAL : 45 PERIODS

COURSE OUTCOMES
● Understand the relevance of standards and specifications.
● Summarize the various test methods for evaluating the mechanical properties of the polymers.
● To know the thermal, electrical & optical properties of polymers.
● Identify various techniques used for characterizing polymers.
● Distinguish the processability tests used for thermoplastics, thermosets and elastomers.

REFERENCES:
1. F. Majewska, H. Zowall, Handbook of analysis of synthetic polymers and plastics, Ellis Horwood
   Limited Publisher 1977.
   Delhi, 2003.

OEC353         VLSI DESIGN 3 0 0 3

OBJECTIVES:
● Understand the fundamentals of IC technology components and their characteristics.
● Understand combinational logic circuits and design principles.
● Understand sequential logic circuits and clocking strategies.
● Understand Interconnects and Memory Architecture.
• Understand the design of arithmetic building blocks

UNIT I    MOS TRANSISTOR PRINCIPLES
MOS logic families (NMOS and CMOS), Ideal and Non Ideal IV Characteristics, CMOS devices. 
MOS(FET) Transistor DC transfer Characteristics ,small signal analysis of MOSFET.

UNIT II    COMBINATIONAL LOGIC CIRCUITS
Propagation Delays, stick diagram, Layout diagrams, Examples of combinational logic design, Elmore's 

UNIT III    SEQUENTIAL LOGIC CIRCUITS AND CLOCKING STRATEGIES
Static Latches and Registers, Dynamic Latches and Registers, Pipelines, Timing classification of Digital 

UNIT IV    INTERCONNECT, MEMORY ARCHITECTURE
Interconnect Parameters – Capacitance, Resistance, and Inductance, Logic Implementation using 
Programmable Devices (ROM, PLA, FPGA), Memory Architecture and Building Blocks.

UNIT V    DESIGN OF ARITHMETIC BUILDING BLOCKS
Arithmetic Building Blocks: Data Paths, Adders-Ripple Carry Adder, Carry-Bypass Adder, Carry Select 
Adder, Carry-Look Ahead Adder, Multipliers, Barrel Shifter, power and speed tradeoffs.

TOTAL: 45 PERIODS

OUTCOMES:
Upon successful completion of the course the student will be able to

CO1: Understand the working principle and characteristics of MOSFET
CO2: Design Combinational Logic Circuits
CO3: Design Sequential Logic Circuits and Clocking systems
CO4: Understand Memory architecture and interconnects
CO5: Design of arithmetic building blocks.

TEXT BOOKS:
   2016.(Units II, III IV and V).
   Addison Wesley, 2009.( Units - I).

REFERENCES:
2. P. Rashinkar, Paterson and L. Singh, "System-on-a-Chip Verification-Methodology and 
4. M. Bushnell and V. D. Agarwal, "Essentials of Electronic Testing for Digital, Memory and Mixed- 

<table>
<thead>
<tr>
<th>CO</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>
<th>PSO1</th>
<th>PSO2</th>
<th>PSO3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
OBJECTIVES:
The student should be made to:

- To know the hardware requirement of wearable systems
- To understand the communication and security aspects in the wearable devices
- To know the applications of wearable devices in the field of medicine

UNIT I INTRODUCTION TO WEARABLE SYSTEMS AND SENSORS


UNIT II SIGNAL PROCESSING AND ENERGY HARVESTING FOR WEARABLE DEVICES

Wearability issues - physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

UNIT III WIRELESS HEALTH SYSTEMS


UNIT IV SMART TEXTILE


UNIT V APPLICATIONS OF WEARABLE SYSTEMS

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

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

CO1: Describe the concepts of wearable system.
CO2: Explain the energy harvestings in wearable device.
CO3: Use the concepts of BAN in health care.
CO4: Illustrate the concept of smart textile
CO5: Compare the various wearable devices in healthcare system

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES:

CO's- PO's & PSO's MAPPING

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Avg.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CBM356  MEDICAL INFORMATICS  L T P C
3 0 0 3

PREAMBLE:
1. To study the applications of information technology in healthcare management.
2. This course provides knowledge on resources, devices, and methods required to optimize the acquisition, storage, retrieval, and use of information in health and biomedicine.

UNIT I  INTRODUCTION TO MEDICAL INFORMATICS
Introduction - Structure of Medical Informatics - Internet and Medicine - Security issues, Computer based medical information retrieval, Hospital management and information system, Functional capabilities of a computerized HIS, Health Informatics - Medical Informatics, Bioinformatics

UNIT II  COMPUTERS IN CLINICAL LABORATORY AND MEDICAL IMAGING
Automated clinical laboratories - Automated methods in hematology, cytology and histology, Intelligent Laboratory Information System - Computer assisted medical imaging - nuclear medicine, ultrasound imaging, computed X-ray tomography, Radiation therapy and planning, Nuclear Magnetic Resonance.

UNIT III  COMPUTERISED PATIENT RECORD
Introduction - conventional patient record, Components and functionality of CPR, Development tools, Intranet, CPR in Radiology - Application server provider, Clinical information system, Computerized prescriptions for patients.

UNIT IV  COMPUTER ASSISTED MEDICAL DECISION-MAKING
Neuro computers and Artificial Neural Networks application, Expert system-General model of CMD, Computer–assisted decision support system-production rule system cognitive model, semantic networks, decisions analysis in clinical medicine-computers in the care of critically ill patients, Computer aids for the handicapped.

UNIT V  RECENT TRENDS IN MEDICAL INFORMATICS
Virtual reality applications in medicine, Virtual endoscopy, Computer assisted surgery, Surgical simulation, Telemedicine - Tele surgery, Computer assisted patient education and health- Medical education and healthcare information, computer assisted instruction in medicine.

**COURSE OUTCOMES:**
Upon completion of the course, students will be able to:
1. Explain the structure and functional capabilities of Hospital Information System.
2. Describe the need of computers in medical imaging and automated clinical laboratory.
3. Articulate the functioning of information storage and retrieval in computerized patient record system.
4. Apply the suitable decision support system for automated clinical diagnosis.
5. Discuss the application of virtual reality and telehealth technology in medical industry.

**TEXT BOOKS:**

**REFERENCES:**

**CO’s- PO’s & PSO’s MAPPING**

<table>
<thead>
<tr>
<th>CO’s PO’s</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>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>AVg.</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>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**OBT355**  
BIOTECHNOLOGY FOR WASTE MANAGEMENT  
L T P C  
3 0 0 3

**UNIT I**  
**BIOLOGICAL TREATMENT PROCESS**  
9

**UNIT II**  
**WASTE BIOMASS AND ITS VALUE ADDITION**  
9
Types of waste biomass – Solid waste management - Nature of biomass feedstock – Biobased economy/process – Value addition of waste biomass – Biotransformation of biomass – Biotransformation of marine processing wastes – Direct extraction of biochemicals from biomass – Plant biomass for industrial application

**UNIT III**  
**BIOCONVERSION OF WASTES TO ENERGY**  
9
Perspective of biofuels from wastes - Bioethanol production – Biohydrogen Production – dark and photofermentative process - Biobutanol production – Biogas and Biomethane production - Single stage
anaerobic digestion, Two stage anaerobic digestion - Biodiesel production - Enzymatic hydrolysis technologies

UNIT IV CHEMICALS AND ENZYME PRODUCTION FROM WASTES
Production of lactic acid, succinic acid, citric acid – Biopolymer synthesis – Production of Amylases - Lignocellulolytic enzymes - Pectinolytic enzymes - Proteases – Lipases

UNIT V BIOCOMPOSTING OF ORGANIC WASTES
Overview of composting process - Benefits of composting, Role of microorganisms in composting - Factors affecting the composting process - Waste Materials for Composting, Fundamentals of composting process - Composting technologies, Composting systems – Nonreactor Composting, Reactor composting - Compost Quality

TOTAL: 45 PERIODS

COURSE OUTCOMES
After completion of this course, the students should be able
1. To learn the various methods biological treatment
2. To know the details of waste biomass and its value addition
3. To develop the bioconversion processes to convert wastes to energy
4. To synthesize the chemicals and enzyme from wastes
5. To produce the biocompost from wastes
6. To apply the theoretical knowledge for the development of value added products

TEXT BOOKS

REFERENCE BOOKS

OBT356 LIFESTYLE DISEASES L T P C 3 0 0 3

UNIT I INTRODUCTION
Lifestyle diseases – Definition ; Risk factors – Eating, smoking, drinking, stress, physical activity, illicit drug use ; Obesity, diabetes, cardiovascular diseases, respiratory diseases, cancer; Prevention – Diet and exercise.

UNIT II CANCER
Types - Lung cancer, Mouth cancer, Skin cancer, Cervical cancer, Carcinoma oesophagus; Causes Tobacco usage, Diagnosis – Biomarkers, Treatment
UNIT III  CARDIOVASCULAR DISEASES  9
Coronary atherosclerosis – Coronary artery disease; Causes -Fat and lipids, Alcohol abuse – Diagnosis - Electrocardiograph, echocardiograph, Treatment, Exercise and Cardiac rehabilitation

UNIT IV  DIABETES AND OBESITY  9
Types of Diabetes mellitus; Blood glucose regulation; Complications of diabetes – Paediatric and adolescent obesity – Weight control and BMI

UNIT V  RESPIRATORY DISEASES  9
Chronic lung disease, Asthma, COPD; Causes - Breathing pattern (Nasal vs mouth), Smoking – Diagnosis - Pulmonary function testing

TEXT BOOKS:

REFERENCES:

OBT357  BIOTECHNOLOGY IN HEALTH CARE  L T P C
3 0 0 3

COURSE OBJECTIVES
The aim of this course is to
1. Create higher standard of knowledge on healthcare system and services
2. Prioritize advanced technologies for the diagnosis and treatment of various diseases

UNIT I  PUBLIC HEALTH  9

UNIT II  CLINICAL DISEASES  9
Communicable diseases: Chickenpox / Shingles, COVID-19, Tuberculosis, Hepatitis B, Hepatitis C, HIV / AIDS, Influenza, Swine flu. Non Communicable diseases: Diabetes mellitus, atherosclerosis, fatty liver, Obesity, Cancer

UNIT III  VACCINOLOGY  9
History of Vaccinology, conventional approaches to vaccine development, live attenuated and killed vaccines, adjuvants, quality control, preservation and monitoring of microorganisms in seed lot systems. Instruments related to monitoring of temperature, sterilization, environment.

UNIT IV  OUTPATIENT & IN PATIENT SERVICES  9
Radiotherapy, Nuclear medicine, surgical units, OT Medical units, G & Obs. units Pediatric, neonatal units, Critical care units, Physical medicine & Rehabilitation, Neurology, Gastroenterology, Endoscopy, Pulmonology, Cardiology.
UNIT V  BASICS OF IMAGING MODALITIES  

TEXT BOOKS:

REFERENCE BOOKS:

VERTICAL 1: FINTECH AND BLOCK CHAIN
CMG331  FINANCIAL MANAGEMENT  LT P C
3 0 0 3

LEARNING OBJECTIVES
1. To acquire the knowledge of the decision areas in finance.
2. To learn the various sources of Finance
3. To describe about capital budgeting and cost of capital.
4. To discuss on how to construct a robust capital structure and dividend policy
5. To develop an understanding of tools on Working Capital Management.

UNIT I  INTRODUCTION TO FINANCIAL MANGEMENT
Definition and Scope of Finance Functions - Objectives of Financial Management - Profit Maximization and Wealth Maximization- Time Value of money- Risk and return concepts.

UNIT II . SOURCES OF FINANCE
Long term sources of Finance -Equity Shares – Debentures - Preferred Stock – Features – Merits and Demerits. Short term sources - Bank Sources, Trade Credit, Overdrafts, Commercial Papers, Certificate of Deposits, Money market mutual funds etc

UNIT III  INVESTMENT DECISIONS
Cost of Capital - Cost of Specific Sources of Capital - Equity -Preferred Stock- Debt - Reserves - Concept and measurement of cost of capital - Weighted Average Cost of Capital.

UNIT IV  FINANCING AND DIVIDEND DECISION

346

UNIT V WORKING CAPITAL DECISION

TOTAL : 45 PERIODS

TEXT BOOKS

REFERENCES
2. Prasanna Chandra, Financial Management,

CMG332 FUNDAMENTALS OF INVESTMENT L T P C
3 0 0 3

OBJECTIVES:
1. Describe the investment environment in which investment decisions are taken.
2. Explain how to Value bonds and equities
3. Explain the various approaches to value securities
4. Describe how to create efficient portfolios through diversification
5. Discuss the mechanism of investor protection in India.

UNITI THE INVESTMENT ENVIRONMENT
The investment decision process, Types of Investments – Commodities, Real Estate and Financial Assets, the Indian securities market, the market participants and trading of securities, security market indices, sources of financial information, Concept of return and risk, Impact of Taxes and Inflation on return.

UNIT II FIXED INCOME SECURITIES
Bond features, types of bonds, estimating bond yields, Bond Valuation types of bond risks, default risk and credit rating.

UNIT III APPROACHES TO EQUITY ANALYSIS
Introduction to Fundamental Analysis, Technical Analysis and Efficient Market Hypothesis, dividend capitalisation models, and price-earnings multiple approach to equity valuation.

UNIT IV PORTFOLIO ANALYSIS AND FINANCIAL DERIVATIVES
Portfolio and Diversification, Portfolio Risk and Return; Mutual Funds; Introduction to Financial Derivatives; Financial Derivatives Markets in India
UNIT V    INVESTOR PROTECTION
Role of SEBI and stock exchanges in investor protection; Investor grievances and their redressal system, insider trading, investors’ awareness and activism

TOTAL: 45 PERIODS

REFERENCES:

CMG333    BANKING, FINANCIAL SERVICES AND INSURANCE

OBJECTIVES
- Understand the Banking system in India
- Grasp how banks raise their sources and how they deploy it
- Understand the development in banking technology
- Understand the financial services in India
- Understand the insurance Industry in India

UNIT I    INTRODUCTION TO INDIAN BANKING SYSTEM
Overview of Banking system – Structure – Functions – Banking system in India - Key Regulations in Indian Banking sector – RBI. Relationship between Banker and Customer - Retail & Wholesale Banking – types of Accounts - Opening and operation of Accounts.

UNIT II    MANAGING BANK FUNDS/ PRODUCTS

UNIT III    DEVELOPMENT IN BANKING TECHNOLOGY

UNIT IV    FINANCIAL SERVICES

UNIT V    INSURANCE

TOTAL: 45 PERIODS

REFERENCES:
CMG334  INTRODUCTION TO BLOCKCHAIN AND ITS APPLICATIONS  LT P C

UNIT I  INTRODUCTION TO BLOCKCHAIN
Blockchain: The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Features of a blockchain - Types of blockchain, Consensus: Consensus mechanism - Types of consensus mechanisms - Consensus in blockchain. Decentralization: Decentralization using blockchain - Methods of decentralization - Routes to decentralization- Blockchain and full ecosystem decentralization - Smart contracts - Decentralized Organizations- Platforms for decentralization.

UNIT II  INTRODUCTION TO CRYPTOCURRENCY

UNIT III  ETHEREUM
Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM), Ethereum Development Environment: Test networks - Setting up a private net - Starting up the private network

UNIT IV  WEB3 AND HYPERLEDGE

UNIT V  EMERGING TRENDS

TOTAL: 45 PERIODS

REFERENCE
2. Peter Borovykh , Blockchain Application in Finance, Blockchain Driven, 2nd Edition, 2018

CMG335  FINTECH PERSONAL FINANCE AND PAYMENTS  LT P C

UNIT I  CURRENCY EXCHANGE AND PAYMENT


UNIT II DIGITAL FINANCE AND ALTERNATIVE FINANCE 9
A Brief History of Financial Innovation, Digitization of Financial Services, Crowd funding, Charity and Equity,. Introduction to the concept of Initial Coin Offering

UNIT III INSURETECH 9
InsurTech Introduction , Business model disruption AI/ML in InsurTech IoT and InsurTech ,Risk Modeling, Fraud Detection Processing claims and Underwriting Innovations in Insurance Services

UNIT IV PEER TO PEER LENDING 9
P2P and Marketplace Lending, New Models and New Products in market place lending P2P Infrastructure and technologies , Concept of Crowdfunding Crowdfunding Architecture and Technology , P2P and Crowdfunding unicorns and business models , SME/MSME Lending: Unique opportunities and Challenges, Solutions and Innovations

UNIT V REGULATORY ISSUES 9

TOTAL : 45 PERIODS

REFERENCES:
5. IIBF, Digital Banking, Taxmann Publication, 2016

CMG336 INTRODUCTION TO FINTECH LT P C
3 0 0 3

OBJECTIVES:
1. To learn about history, importance and evolution of Fintech
2. To acquire the knowledge of Fintech in payment industry
3. To acquire the knowledge of Fintech in insurance industry
4. To learn the Fintech developments around the world
5. To know about the future of Fintech

UNIT I INTRODUCTION
Fintech - Definition, History, concept, meaning, architecture, significance, Goals, key areas in Fintech, Importance of Fintech, role of Fintech in economic development, opportunities and challenges in Fintech, Evolution of Fintech in different sectors of the industry - Infrastructure, Banking Industry, Startups and Emerging Markets, recent developments in FinTech, future prospects and potential issues with Fintech.

UNIT II PAYMENT INDUSTRY
FinTech in Payment Industry-Multichannel digital wallets, applications supporting wallets, onboarding and KYC application, FinTech in Lending Industry- Formal lending, Informal lending, P2P lending, POS lending, Online lending, Payday lending, Microfinance, Crowdfunding.

UNIT III INSURANCE INDUSTRY

UNIT IV FINTECH AROUND THE GLOBE

UNIT V FUTURE OF FINTECH
How emerging technologies will change financial services, the future of financial services, banking on innovation through data, why FinTech banks will rule the world, The FinTech Supermarket, Banks partnering with FinTech start-ups, The rise of BankTech, Fintech impact on Retail Banking, A future without money, Ethics in Fintech.

TOTAL:45 PERIODS

REFERENCES
4. Parag Y Arjunwadkar, FinTech: The Technology Driving Disruption in the financial service industry CRC Press, 2018
6. Pranay Gupta, T. Mandy Tham, Fintech: The New DNA of Financial Services Paperback, 2018

VERTICAL 2: ENTREPRENEURSHIP
COURSE OBJECTIVES:
- To develop and strengthen the entrepreneurial quality and motivation of learners.
- To impart the entrepreneurial skills and traits essential to become successful entrepreneurs.
- To apply the principles and theories of entrepreneurship and management in Technology oriented businesses.
- To empower the learners to run a Technology driven business efficiently and effectively.

UNIT I  INTRODUCTION TO ENTREPRENEURSHIP 9
Entrepreneurship - Definition, Need, Scope - Entrepreneurial Skill & Traits - Entrepreneur vs. Intrapreneur; Classification of entrepreneurs, Types of entrepreneurs - Factors affecting entrepreneurial development – Achievement Motivation – Contributions of Entrepreneurship to Economic Development.

UNIT II  BUSINESS OWNERSHIP & ENVIRONMENT 9

UNIT III  FUNDAMENTALS OF TECHNOPRENEURSHIP 9

UNIT IV  APPLICATIONS OF TECHNOPRENEURSHIP 9

UNIT 5  EMERGING TRENDS IN ENTREPRENEURSHIP 9

TOTAL 45 : PERIODS

OUTCOMES:
Upon completion of this course, the student should be able to:
CO 1 Learn the basics of Entrepreneurship
CO 2 Understand the business ownership patterns and environment
CO 3 Understand the Job opportunities in Industries relating to Technopreneurship
CO 4 Learn about applications of technopreneurship and successful technopreneurs
CO 5 Acquaint with the recent and emerging trends in entrepreneurship

TEXT BOOKS:

REFERENCES:
4) David Sheff 2002, China Dawn: The Story of a Technology and Business Revolution,
7) Basics of Technoprenuership: Module 1.1-1.2, Frederico Gonzales, President-PESO Inc; M. Barcelon, UP
8) Journal articles pertaining to Entrepreneurship

CMG338 TEAM BUILDING & LEADERSHIP MANAGEMENT FOR BUSINESS L T P C 3 0 0 3

COURSE OBJECTIVES:
- To develop and strengthen the Leadership qualities and motivation of learners.
- To impart the Leadership skills and traits essential to become successful entrepreneurs.
- To apply the principles and theories of Team Building in managing Technology oriented businesses.
- To empower the learners to build robust teams for running and leading a business efficiently and effectively

UNIT I INTRODUCTION TO MANAGING TEAMS 9
Introduction to Team - Team Dynamics - Team Formation – Stages of Team Development - Enhancing teamwork within a group - Team Coaching - Team Decision Making - Virtual Teams - Self Directed Work Teams (SDWTs) - Multicultural Teams.

UNIT II MANAGING AND DEVELOPING EFFECTIVE TEAMS 9
Team-based Organisations- Leadership roles in team-based organisations - Offsite training and team development - Experiential Learning - Coaching and Mentoring in team building - Building High-Performance Teams - Building Credibility and Trust - Skills for Developing Others - Team Building at the Top - Leadership in Teamwork Effectiveness.

UNIT III INTRODUCTION TO LEADERSHIP 9
Introduction to Leadership - Leadership Myths – Characteristics of Leader, Follower and Situation - Leadership Attributes - Personality Traits and Leadership- Intelligence Types and Leadership - Power and Leadership - Delegation and Empowerment.

UNIT IV LEADERSHIP IN ORGANISATIONS 9

UNIT V LEADERSHIP EFFECTIVENESS 9

353

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the student should be able to:
CO 1  Learn the basics of managing teams for business.
CO 2  Understand developing effective teams for business management.
CO 3  Understand the fundamentals of leadership for running a business.
CO 4  Learn about the importance of leadership for business development.
CO 5  Acquaint with emerging trends in leadership effectiveness for entrepreneurs.

REFERENCES:

CMG339 CREATIVITY & INNOVATION IN ENTREPRENEURSHIP

COURSE OBJECTIVES
 To develop the creativity skills among the learners
 To impart the knowledge of creative intelligence essential for entrepreneurs
 To know the applications of innovation in entrepreneurship.
 To develop innovative business models for business.

UNIT I CREATIVITY
Creativity: Definition- Forms of Creativity-Essence, Elaborative and Expressive Creativities- Quality of Creativity-Existentail, Entrepreneurial and Empowerment Creativities – Creative Environment- Creative Technology- Creative Personality and Motivation.

UNIT II CREATIVE INTELLIGENCE
Creative Intelligence: Convergent thinking ability – Traits Congenial to creativity – Creativity Training- Criteria for evaluating Creativity-Credible Evaluation- Improving the quality of our creativity – Creative Tools and Techniques - Blocks to creativity- fears and Disabilities- Strategies for Unblocking- Designing Creativity Enabling Environment.

UNIT III INNOVATION
UNIT IV INNOVATION AND ENTREPRENEURSHIP


UNIT V INNOVATIVE BUSINESS MODELS


TOTAL 45 : PERIODS

COURSE OUTCOMES:

Upon completion of this course, the student should be able to:
CO 1 Learn the basics of creativity for developing Entrepreneurship
CO 2 Understand the importance of creative intelligence for business growth
CO 3 Understand the advances through Innovation in Industries
CO 4 Learn about applications of innovation in building successful ventures
CO 5 Acquaint with developing innovative business models to run the business efficiently and effectively

SUGGESTED READINGS:
1. Creativity and Innovation in Entrepreneurship, Kankha, Sultan Chand

CMG340 PRINCIPLES OF MARKETING MANAGEMENT FOR BUSINESS

COURSE OBJECTIVES:

- To provide basic knowledge of concepts, principles, tools and techniques of marketing for entrepreneurs
- To provide an exposure to the students pertaining to the nature and Scope of marketing, which they are expected to possess when they enter the industry as practitioners.
- To give them an understanding of fundamental premise underlying market driven strategies and the basic philosophies and tools of marketing management for business owners.

UNIT I INTRODUCTION TO MARKETING MANAGEMENT

UNIT II MARKETING ENVIRONMENT

UNIT III PRODUCT AND PRICING MANAGEMENT

UNIT IV PROMOTION AND DISTRIBUTUION MANAGEMENT

UNIT V CONTEMPORARY ISSUES IN MARKETING MANAGEMENT

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After completion of this course, the students will be able to:
CO1 Have the awareness of marketing management process
CO 2 Understand the marketing environment
CO 3 Acquaint about product and pricing strategies
CO 4 Knowledge of promotion and distribution in marketing management.
CO 5 Comprehend the contemporary marketing scenarios and offer solutions to marketing issues.

REFERENCES:
OBJECTIVES:
1. To introduce the basic concepts, structure and functions of human resource management for entrepreneurs.
2. To create an awareness of the roles, functions and functioning of human resource department.
3. To understand the methods and techniques followed by Human Resource Management practitioners.

UNIT I             INTRODUCTION TO HRM
9

UNIT II           HUMAN RESOURCE PLANNING
9
HR Planning - Definition - Factors- Tools - Methods and Techniques - Job analysis- Job rotation- Job Description - Career Planning - Succession Planning - HRIS - Computer Applications in HR - Recent Trends

UNIT III RECRUITMENT AND SELECTION
9
Sources of recruitment- Internal Vs. External - Domestic Vs. Global Sources - eRecruitment - Selection Process- Selection techniques - eSelection - Interview Types- Employee Engagement.

UNIT IV TRAINING AND EMPLOYEE DEVELOPMENT
9

UNIT V CONTROLLING HUMAN RESOURCES
9

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course the learners will be able:
CO 1 To understand the Evolution of HRM and Challenges faced by HR Managers
CO 2 To learn about the HR Planning Methods and practices.
CO 3 To acquaint about the Recruitment and Selection Techniques followed in Industries.
CO 4 To known about the methods of Training and Employee Development.
CO 5 To comprehend the techniques of controlling human resources in organisations.

REFERENCES:
CMG342 FINANCING NEW BUSINESS VENTURES

**COURSE OBJECTIVES:**
- To develop the basics of business venture financing.
- To impart the knowledge essential for entrepreneurs for financing new ventures.
- To acquaint the learners with the sources of debt and equity financing.
- To empower the learners towards fund raising for new ventures effectively.

**UNIT I ESSENTIALS OF NEW BUSINESS VENTURE**

**UNIT II INTRODUCTION TO VENTURE FINANCING**

**UNIT III SOURCES OF DEBT FINANCING**

**UNIT IV SOURCES OF EQUITY FINANCING**
Own Capital, Unsecured Loan - Government Subsidies , Margin Money- Equity Funding - Private Equity Fund- Schemes of Commercial banks - Angel Funding – Crowdfunding- Venture Capital.

**UNIT V METHODS OF FUND RAISING FOR NEW VENTURES**

**TOTAL: 45 PERIODS**

**OUTCOMES:**
Upon completion of this course, the students should be able to:
- CO 1 Learn the basics of starting a new business venture.
- CO 2 Understand the basics of venture financing.
- CO 3 Understand the sources of debt financing.
- CO 4 Understand the sources of equity financing.
CO 5  Acquaint with the methods of fund raising for new business ventures.

REFERENCES:
1) Principles of Corporate Finance by Brealey and Myers et al., 12th ed, McGraw Hill Education (India) Private Limited, 2018

VERTICAL 3: PUBLIC ADMINISTRATION

CMG343 PRINCIPLES OF PUBLIC ADMINISTRATION

UNIT-I
1. Meaning, Nature and Scope of Public Administration
2. Importance of Public Administration
3. Evolution of Public Administration

UNIT-II
1. New Public Administration
2. New Public Management
3. Public and Private Administration

UNIT-III
1. Relationships with Political Science, History and Sociology
2. Classical Approach
3. Scientific Management Approach

UNIT-IV
1. Bureaucratic Approach: Max Weber
2. Human Relations Approach: Elton Mayo
3. Ecological Approach: Riggs

UNIT-V
1. Leadership: Leadership - Styles - Approaches
2. Communication: Communication Types - Process - Barriers

TOTAL: 45 PERIODS

REFERENCES:
5. R. Tyagi, Public Administration, Atma Ram & Sons, New Delhi, 1983.
UNIT- I
1. Constitutional Development Since 1909 to 1947
3. Constituent Assembly

UNIT-II
1. Fundamental Rights
2. Fundamental Duties
3. Directive Principles of State Policy

UNIT-III
1. President
2. Parliament
3. Supreme Court

UNIT-IV
1. Governor
2. State Legislature
3. High Court

UNIT-V
1. Secularism
2. Social Justice
3. Minority Safeguards

REFERENCES:
4. Agarwal R.C: Indian Political System; S.Chand & Co., New Delhi

TOTAL: 45 PERIODS

UNIT-I
1. Meaning, Scope and Importance of Personnel Administration
2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems

UNIT-II
1. Generalist Vs Specialist
2. Civil Servants' Relationship with Political Executive
3. Integrity in Administration.

UNIT-III
1. Recruitment: Direct Recruitment and Recruitment from Within
2. Training: Kinds of Training
3. Promotion

CMG345
PUBLIC PERSONNEL ADMINISTRATION

UNIT-I
1. Meaning, Scope and Importance of Personnel Administration
2. Types of Personnel Systems: Bureaucratic, Democratic and Representative systems

UNIT-II
1. Generalist Vs Specialist
2. Civil Servants' Relationship with Political Executive
3. Integrity in Administration.

UNIT-III
1. Recruitment: Direct Recruitment and Recruitment from Within
2. Training: Kinds of Training
3. Promotion

TOTAL: 45 PERIODS
UNIT-IV
1. All India Services
2. Service Conditions
3. State Public Service Commission

UNIT-V
1. Employer Employee Relations
2. Wage and Salary Administration
3. Allowances and Benefits

REFERENCES:
1. Stahl Glean O: Public Personnel Administration
4. Dwivedi O.P and Jain R.B: India’s Administrative state.
7. Davar R.S. Personnel Management & Industrial Relations

TOTAL: 45 PERIODS

CMG346
ADMINISTRATIVE THEORIES

UNIT I
Meaning, Scope and significance of Public Administration, Evolution of Public Administration as a
discipline and Identity of Public Administration

UNIT II
Theories of Organization: Scientific Management Theory, Classical Model,
Human Relations Theory

UNIT III
Organization goals and Behaviour, Groups in organization and group dynamics, Organizational Design.

UNIT IV
Motivation Theories, content, process and contemporary; Theories of Leadership: Traditional and
Modern: Process and techniques of decision-making

UNIT V
Administrative thinkers: Kautilya, Woodrow Willson, C.I. Barnard . Peter Drucker

REFERENCES:
1. Crozior M : The Bureaucratic phenomenon (Chand)
3. Presthus. R : The Organizational Society (MAC)
5. Keith Davis : Organization Theory (MAC)

TOTAL: 45 PERIODS
CMG347  INDIAN ADMINISTRATIVE SYSTEM  L T P C 3 0 0 3

UNIT I  
Evolution and Constitutional Context of Indian Administration, Constitutional Authorities: Finance Commission, Union Public Services Commission, Election Commission, Comptroller and Auditor General of India, Attorney General of India

UNIT II  
Role & Functions of the District Collector, Relationship between the District Collector and Superintendent of Police, Role of Block Development Officer in development programmes, Local Government

UNIT III  
Main Features of 73rd Constitutional Amendment Act 1992, Salient Features of 74th Constitutional Amendment Act 1992

UNIT IV  
Coalition politics in India, Integrity and Vigilance in Indian Administration

UNIT V  
Corruption – Ombudsman, Lok Pal & Lok Ayuktha

TOTAL: 45 PERIODS

REFERENCES:
1. S.R. Maheswari : Indian Administration
2. Khera. S.S : Administration in India
3. Ramesh K. Arora : Indian Public Administration
4. T.N. Chaturvedi : State administration in India
5. Basu, D.D : Introduction to the Constitution of India

CMG348  PUBLIC POLICY ADMINISTRATION  L T P C 3 0 0 3

UNIT-I  

UNIT-II  
Approaches in Policy Analysis - Institutional Approach – Incremental Approach and System’s Approach – Dror’s Optimal Model

UNIT-III  

UNIT-IV  
Institutional Framework of Policy making – Role of Bureaucracy – Role of Interest Groups and Role of Political Parties.
UNIT-V
Introduction to the following Public Policies – New Economic Policy – Population Policy – Agriculture policy - Information Technology Policy.

REFERENCES:
4. Pradeep Saxena : Public Policy Administration and Development

TOTAL: 45 PERIODS

VERTICAL 4: BUSINESS DATA ANALYTICS

CMG349 STATISTICS FOR MANAGEMENT

OBJECTIVE:
- To learn the applications of statistics in business decision making.

UNIT I INTRODUCTION
Basic definitions and rules for probability, Baye's theorem and random variables, Probability distributions: Binomial, Poisson, Uniform and Normal distributions.

UNIT II SAMPLING DISTRIBUTION AND ESTIMATION
Introduction to sampling distributions, Central limit theorem and applications, sampling techniques, Point and Interval estimates of population parameters.

UNIT III TESTING OF HYPOTHESIS - PARAMETRIC TESTS
Hypothesis testing: one sample and two sample tests for means of large samples (z-test), one sample and two sample tests for means of small samples (t-test), ANOVA one way.

UNIT IV NON-PARAMETRIC TESTS

UNIT V CORRELATION AND REGRESSION

OUTCOMES:
- To facilitate objective solutions in business decision making.
- To understand and solve business problems
- To apply statistical techniques to data sets, and correctly interpret the results.
- To develop skill-set that is in demand in both the research and business environments
- To enable the students to apply the statistical techniques in a work setting.

REFERENCES:
5. David R. Anderson, Dennis J. Sweeney, Thomas A. Williams, Jeffrey D. Camm, James

CMG350                  DATAMINING FOR BUSINESS INTELLIGENCE                                L T P C
3 0 0 3

OBJECTIVES:
- To know how to derive meaning from huge volume of data and information.
- To understand how knowledge discovering process is used in business decision making.

UNIT I                   INTRODUCTION
Data mining, Text mining, Web mining, Data warehouse.

UNIT II                  DATA MINING PROCESS
Datamining process – KDD, CRISP-DM, SEMMA
Prediction performance measures

UNIT III                 PREDICTION TECHNIQUES
Data visualization, Time series – ARIMA, Winter Holts,

UNIT IV                  CLASSIFICATION AND CLUSTERING TECHNIQUES
Classification, Association, Clustering.

UNIT V                   MACHINE LEARNING AND AI
Genetic algorithms, Neural network, Fuzzy logic, Ant Colony optimization, Particle Swarm optimization

TOTAL: 45 PERIODS

OUTCOMES:
1. Learn to apply various data mining techniques into various areas of different domains.
2. Be able to interact competently on the topic of data mining for business intelligence.
3. Apply various prediction techniques.
4. Learn about supervised and unsupervised learning technique.
5. Develop and implement machine learning algorithms

REFERENCES:
1. Jaiwei Ham and Micheline Kamber, Data Mining concepts and techniques, Kauffmann Publishers 2006
2. Efraim Turban, Ramesh Sharda, Jay E. Aronson and David King, Business Intelligence, Prentice Hall, 2008.

365
CMG351  HUMAN RESOURCE ANALYTICS  L T P C
3 0 0 3

OBJECTIVES:
- To develop the ability of the learners to define and implement HR metrics that are aligned with the overall business strategy.
- To know the different types of HR metrics and understand their respective impact and application.
- To understand the impact and use of HR metrics and their connection with HR analytics.
- To understand common workforce issues and resolving them using people analytics.

UNIT I  INTRODUCTION TO HR ANALYTICS
People Analytics - stages of maturity - Human Capital in the Value Chain: impact on business – HR metrics and KPIs.

UNIT II  HR ANALYTICS I: RECRUITMENT
Recruitment Metrics: Fill-up ratio - Time to hire - Cost per hire - Early turnover - Employee referral hires - Agency hires - Lateral hires - Fulfillment ratio - Quality of hire.

UNIT III  HR ANALYTICS II: TRAINING AND DEVELOPMENT
Training & Development Metrics: Percentage of employees trained - Internally and externally trained - Training hours and cost per employee - ROI.

UNIT IV  HR ANALYTICS III: EMPLOYEE ENGAGEMENT AND CAREER PROGRESSION
Employee Engagement Metrics: Talent Retention index - Voluntary and involuntary turnover - grades, performance, and service tenure - Internal hired index Career Progression Metrics: Promotion index - Rotation index - Career path index.

UNIT V - HR ANALYTICS IV: WORKFORCE DIVERSITY AND DEVELOPMENT
Workforce Diversity and Development Metrics: Employees per manager - Workforce age profiling - Workforce service profiling - Churnover index - Workforce diversity index - Gender mix

TOTAL: 45 PERIODS

OUTCOME:
- The learners will be conversant about HR metrics and ready to apply at work settings.
- The learners will be able to resolve HR issues using people analytics.

REFERENCES:

CMG352 MARKETING AND SOCIAL MEDIA WEB ANALYTICS

OBJECTIVE:
To showcase the opportunities that exist today to leverage the power of the web and social media.

UNIT I MARKETING ANALYTICS
Marketing Budget and Marketing Performance Measure, Marketing - Geographical Mapping, Data Exploration, Market Basket Analysis

UNIT II COMMUNITY BUILDING AND MANAGEMENT
History and Evolution of Social Media - Understanding Science of Social Media - Goals for using Social Media - Social Media Audience and Influencers - Digital PR - Promoting Social Media Pages - Linking Social Media Accounts - The Viral Impact of Social Media.

UNIT III SOCIAL MEDIA POLICIES AND MEASUREMENTS
Social Media Policies - Etiquette, Privacy - ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.

UNIT IV WEB ANALYTICS
Data Collection, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Proposals & Reports, Web Data Analysis.

UNIT V SEARCH ANALYTICS
Search engine optimization (SEO), user engagement, user-generated content, web traffic analysis, online security, online ethics, data visualization.

TOTAL: 45 PERIODS

OUTCOME:
- The Learners will understand social media, web and social media analytics and their potential impact.

REFERENCES:
CMG353  OPERATION AND SUPPLY CHAIN ANALYTICS  L T P C  3 0 0 3

OBJECTIVE:
To treat the subject in depth by emphasizing on the advanced quantitative models and methods in operations and supply chain management and its practical aspects and the latest developments in the field.

UNIT I  INTRODUCTION 9
Descriptive, predictive and prescriptive analytics, Data Driven Supply Chains – Basics, transforming supply chains.

UNIT II  WAREHOUSING DECISIONS 9
P-Median Methods - Guided LP Approach, Greedy Drop Heuristics, Dynamic Location Models, Space Determination and Layout Methods.

UNIT III  INVENTORY MANAGEMENT 9
Dynamic Lot sizing Methods, Multi-Echelon Inventory models, Aggregate Inventory system and LIMIT, Risk Analysis in Supply Chain, Risk pooling strategies.

UNIT IV  TRANSPORTATION NETWORK MODELS 9

UNIT V  MCDM MODELS 9
Analytic Hierarchy Process (AHP), Data Envelopment Analysis (DEA), Fuzzy Logic and Techniques, the analytical network process (ANP), TOPSIS.

TOTAL: 45 PERIODS

OUTCOME:
• To enable quantitative solutions in business decision making under conditions of certainty, risk and uncertainty.

REFERENCES:

368
CMG354  FINANCIAL ANALYTICS  L T P C  3 0 0 3

OBJECTIVE:
- This course introduces a core set of modern analytical tools that specifically target finance applications.

UNIT I  CORPORATE FINANCE ANALYSIS  9
Basic corporate financial predictive modelling - Project analysis - cash flow analysis - cost of capital, Financial Break even modelling, Capital Budget model - Payback, NPV, IRR.

UNIT II  FINANCIAL MARKET ANALYSIS  9
Estimation and prediction of risk and return (bond investment and stock investment) – Time series - examining nature of data, Value at risk, ARMA, ARCH and GARCH.

UNIT III  PORTFOLIO ANALYSIS  9
Portfolio Analysis – capital asset pricing model, Sharpe ratio, Option pricing models - binomial model for options, Black Scholes model and Option implied volatility.

UNIT IV  TECHNICAL ANALYSIS  9

UNIT V  CREDIT RISK ANALYSIS  9
Credit Risk analysis - Data processing, Decision trees, logistic regression and evaluating credit risk model.

TOTAL: 45 PERIODS

OUTCOME
- The learners should be able to perform financial analysis for decision making using excel, Python and R.

REFERENCES:

VERTICAL 5: ENVIRONMENT AND SUSTAINABILITY

CES331  SUSTAINABLE INFRASTRUCTURE DEVELOPMENT  L T P C  3 0 0 3

OBJECTIVE:
- To impart knowledge about sustainable Infrastructure development goals, practices and to understand the concepts of sustainable planning, design, construction, maintenance and decommissioning of infrastructure projects.
UNIT I  SUSTAINABLE DEVELOPMENT GOALS

UNIT II  SUSTAINABLE INFRASTRUCTURE PLANNING

UNIT III  SUSTAINABLE CONSTRUCTION PRACTICES AND TECHNIQUES
Sustainability through lean construction approach - Enabling lean through information technology – Lean in planning and design - IPD (Integrated Project Delivery) - Location Based Management System - Geospatial Technologies for machine control; site management, precision control and real time progress monitoring - Role of logistics in achieving sustainable construction – Data management for integrated supply chains in construction - Resource efficiency benefits of effective logistics - Sustainability in geotechnical practice – Design considerations, Design Parameters and Procedures – Quality control and Assurance - Use of sustainable construction techniques: Precast concrete technology, Pre-engineered buildings.

UNIT IV  SUSTAINABLE CONSTRUCTION MATERIALS

UNIT V  SUSTAINABLE MAINTENANCE OF INFRASTRUCTURE PROJECTS

OUTCOME:
On completion of the course, the student is expected to be able to
CO1 Understand the environment sustainability goals at global and Indian scenario.
CO2 Understand risks in development of projects and suggest mitigation measures.

TOTAL: 45 PERIODS
CO3 Apply lean techniques, LBMS and new construction techniques to achieve sustainability in infrastructure construction projects.

CO4 Explain Life Cycle Analysis and life cycle cost of construction materials.

CO5 Explain the new technologies for maintenance of infrastructure projects.

REFERENCES:
5. New Building Materials and Construction World magazine
7. Munier N, "Introduction to Sustainability", Springer2005

CO's- PO's & PSO's MAPPING

<table>
<thead>
<tr>
<th>CO's</th>
<th>PO's</th>
<th>PSO's</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Avg.</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

CES332 SUSTAINABLE AGRICULTURE AND ENVIRONMENTAL MANAGEMENT

OBJECTIVES:
- To educate the students about the issues of sustainability in agroecosystems, introduce the concepts and principles of agroecology as applied to the design and management of sustainable agricultural systems for a changing world.

UNIT I AGROECOLOGY, AGROECOSYSTEM AND SUSTAINABLE AGRICULTURE CONCEPTS
Ecosystem definition - Biotic Vs. abiotic factors in an ecosystem - Ecosystem processes - Ecological services and agriculture - Problems associated with industrial agriculture/food systems - Defining sustainability - Characteristics of sustainable agriculture - Difference between regenerative and sustainable agriculture systems

UNIT II    SOIL HEALTH, NUTRIENT AND PEST MANAGEMENT  9
Soil health definition - Factors to consider (physical, chemical and biological) - Composition of healthy soils - Soil erosion and possible control measures - Techniques to build healthy soil - Management practices for improving soil nutrient - Ecologically sustainable strategies for pest and disease control

UNIT III   WATER MANAGEMENT  9
Soil water storage and availability - Plant yield response to water - Reducing evaporation in agriculture - Earthworks and tanks for rainwater harvesting - Options for improving the productivity of water - Localized irrigation - Irrigation scheduling - Fertigation - Advanced irrigation systems and agricultural practices for sustainable water use

UNIT IV    ENERGY AND WASTE MANAGEMENT  9
Types and sources of agricultural wastes - Composition of agricultural wastes - Sustainable technologies for the management of agricultural wastes - Useful and high value materials produced using different processes from agricultural wastes - Renewable energy for sustainable agriculture

UNIT V   EVALUATING SUSTAINABILITY IN AGROECOSYSTEMS  9
Indicators of sustainability in agriculture - On-farm evaluation of agroecosystem sustainability - Alternative agriculture approaches/ farming techniques for sustainable food production - Goals and components of a community food system - Case studies

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to
CO1 Have an in-depth knowledge about the concepts, principles and advantages of sustainable agriculture
CO2 Discuss the sustainable ways in managing soil health, nutrients, pests and diseases
CO3 Suggest the ways to optimize the use of water in agriculture to promote an ecological use of resources
CO4 Develop energy and waste management plans for promoting sustainable agriculture in non-sustainable farming areas
CO5 Assess an ecosystem for its level of sustainability and prescribe ways of converting to a sustainable system through the redesign of a conventional agroecosystem

REFERENCES:
1. Approaches to Sustainable Agriculture – Exploring the Pathways Towards the Future of Farming, Oberc, B.P. & Arroyo Schnell, A., IUCN, Belgium, 2020

CO – PO Mapping - SUSTAINABLE AGRICULTURE PRACTICES

<table>
<thead>
<tr>
<th>CO’s</th>
<th>PO’s</th>
<th>PSO’s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
OBJECTIVES

- To Impart knowledge of biomaterials and their properties
- To learn about Fundamentals aspects of Biopolymers and their applications
- To learn about bioceramics and biopolymers
- To introduce the students about metals as biomaterials and their usage as implants
- To make the students understand the significance of bionanomaterials and its applications.

UNIT I  INTRODUCTION TO BIOMATERIALS


UNIT II  BIO POLYMERS

Molecular structure of polymers -Molecular weight - Types of polymerization techniques –Types of polymerization reactions- Physical states of polymers- Common polymeric biomaterials -Polyethylene - Polymethylmethacrylate (PMMA)- Polylactic acid (PLA) and polyglycolic acid (PGA) -Polycaprolactone (PCL) - Other biodegradable polymers –Polyurethan- reactions polymers for medical purposes - Collagens- Elastin- Cellulose and derivatives-Synthetic polymeric membranes and their biological applications

UNIT III  BIO CERAMICS AND BIOCOMPOSITES

General properties- Bio ceramics -Silicate glass - Alumina (Al2O3) -Zirconia (ZrO2)-Carbon- Calcium phosphates (CaP)- Resorbable Ceramics- surface reactive ceramics- Biomedical Composites-Polymer Matrix Composite(PMC)-Ceramic Matrix Composite(CMC)-Metal Matrix Composite (MMC)–glass ceramics - Orthopedic implants-Tissue engineering scaffolds

UNIT IV METALS AS BIOMATERIALS

Biomedical metals-types and properties-stainless steel-Cobalt chromium alloys-Titanium alloys-Tantalum-Nickel titanium alloy (Nitinol)- magnesium-based biodegradable alloys-surface properties of metal implants for osteointegration-medical application-corrosion of metallic implants – biological tolerance of implant metals

UNIT V  NANOBIOIMATERIALS

Metallicnanobiomaterials–Nanopolymers-Nanoceramics- Nanocomposites -Carbon based nanobiomaterials - transport of nanoparticles- release rate-positive and negative effect of nanosize-nanofibres-Nano and micro features and their importance in implant performance-Nanosurface and
coats—Applications nanoantibiotics—Nanomedicines—Biochips—Biomimetics—BioNEMs—Biosensor—Bioimaging/Molecular Imaging—challenges and future perspective.

TOTAL: 45 PERIODS

OUTCOMES
- Students will gain familiarity with Biomaterials and they will understand their importance.
- Students will get an overview of different biopolymers and their properties.
- Students gain knowledge on some of the important Bioceramics and Biocomposite materials.
- Students gain knowledge on metals as biomaterials.
- Students gain knowledge on the importance of nanobiomaterials in biomedical applications.

REFERENCES
6. VasifHasirci, NesrinHasirci “Fundamentals of Biomaterials” Springer, 2018

CES334 MATERIALS FOR ENERGY SUSTAINABILITY

OBJECTIVES
- To familiarize the students about the challenges and demands of energy sustainability.
- To provide fundamental knowledge about electrochemical devices and the materials used.
- To introduce the students to various types of fuel cell.
- To enable students to appreciate novel materials and their usage in photovoltaic application.
- To introduce students to the basic principles of various types Supercapacitors and the materials used.

UNIT I SUSTAINABLE ENERGY SOURCES
Introduction to energy demand and challenges ahead – sustainable source of energy (wind, solar etc.) – electrochemical energy systems for energy harvesting and storage – materials for sustainable electrochemical systems building – India centric solutions based on locally available materials – Economics of wind and solar power generators vs. conventional coal plants – Nuclear energy

UNIT II ELECTROCHEMICAL DEVICES
Electrochemical Energy – Difference between primary and secondary batteries – Secondary battery (Li-ion battery, Sodium-ion battery, Li-S battery, Li-O2 battery, Nickel Cadmium, Nickel Metal Hydride) – Primary battery (Alkaline battery, Zinc-Carbon battery) – Materials for battery (Anode materials – Lithiated graphite, Sodiated hard carbon, Silicon doped graphene, Lithium Titanate) (Cathode Materials – S, LiCoO2, LiFePO4, LiMn2O4) – Electrolytes for Lithium-ion battery (ethylene carbonate and propylene carbonate based)
UNIT III  FUEL CELLS

UNIT IV  PHOTOVOLTAICS

UNIT V  SUPERCAPACITORS
Supercapacitor – types of supercapacitors (electrostatic double-layer capacitors, pseudo capacitors and hybrid capacitors) - design of supercapacitor-three and two electrode cell-parameters of supercapacitor-Faradaic and non-Faradaic capacitance – electrode materials (transition metal oxides (MO), mixed metal oxides, conducting polymers (CP), Mxenes, nanocarbons, non-noble metal, chalcogenides, hydroxides and 1D-3D metal-organic frame work (MOF), activated carbon fibres (ACF)- Hydroxides-Based Materials - Polyaniline (PANI), a ternary hybrid composite-conductive polypyrrole hydrogels – Different types of nanocomposites for the SC electrodes (carbon-carbon composites, carbon-MOs composites, carbon-CPs composites and MOs-CPs composites) - Two-Dimensional (2D) Electrode Materials - 2D transition metal carbides, carbonitrides, and nitrides.

OUTCOMES
• Students will acquire knowledge about energy sustainability.
• Students understand the principles of different electrochemical devices.
• Students learn about the working of fuel cells and their application.
• Students will learn about various Photovoltaic applications and the materials used.
• The students gain knowledge on different types of supercapacitors and the performance of various materials

REFERENCES
5. Materials for Supercapacitor applications; B.Viswanathan. M.Aulice Scibioh

OBJECTIVES:
- to understand and study the complexity of the environment in relation to pollutants generated due to industrial activity.
- To analyze the quality of the environmental parameters and monitor the same for the purpose of environmental risk assessment.

UNIT I  ENVIRONMENTAL MONITORING AND STANDARDS

UNIT II  MONITORING OF ENVIRONMENTAL PARAMETERS

UNIT III  ANALYTICAL METHODS FOR ENVIRONMENTAL MONITORING
Classification of Instrumental Method- Analysis of Organic Pollutants by Spectrophotometric methods - Determination of nitrogen, phosphorus and, chemical oxygen demand (COD) in sewage; Biochemical oxygen demand (BOD)- Sampling techniques for air pollution measurements; analysis of particulates and air pollutants like oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbon; Introduction to advanced instruments for environmental analysis

UNIT IV  ENVIRONMENTAL MONITORING PROGRAMME (EMP) & RISKASSESSMENT

UNIT V  AUTOMATED DATA ACQUISITION AND PROCESSING
Data Acquisition for Process Monitoring and Control - The Data Acquisition System - Online Data Acquisition, Monitoring, and Control - Implementation of a Data Management System - Review of Observational Networks -Sensors and transducers- classification of transducers- data acquisition system- types of data acquisition systems- data management and quality control; regulatory overview.

TOTAL: 45 PERIODS

COURSE OUTCOMES
After completion of this course, the students will know
CO1  Basic concepts of environmental standards and monitoring.
CO2  the ambient air quality and water quality standards;
CO3  the various instrumental methods and their principles for environmental monitoring
CO4  The significance of environmental standards in monitoring quality and sustaining environment.
CO5  the various ways of raising environmental awareness among the people.
CO6  Know the standard research methods that are used worldwide for monitoring the environment.

TEXT BOOKS
2. Handbook of environmental analysis: chemical pollutants in the air, water, soil, and solid wastes / Pradyot Patnaik, © 1997 by CRC Press, Inc

REFERENCES
1. Environmental monitoring / edited by G. Bruce Wiersma, © 2004 by CRC Press LLC.

COURSE ARTICULATION MATRIX

<table>
<thead>
<tr>
<th>Course</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>PO1</th>
<th>PO1</th>
<th>PSC</th>
<th>PS</th>
<th>O2</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO6</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Over all</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CES337  INTEGRATED ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT  L T P C 3 0 0 3

COURSE OBJECTIVES:
1. To create awareness on the energy scenario of India with respect to world
2. To understand the fundamentals of energy sources, energy efficiency and resulting environmental implications of energy utilisation
3. Familiarisation on the concept of sustainable development and its benefits
4. Recognize the potential of renewable energy sources and its conversion technologies for attaining sustainable development
5. Acquainting with energy policies and energy planning for sustainable development

UNIT I  ENERGY SCENARIO  9
Comparison of energy scenario – India and World (energy sources, generation mix, consumption pattern, T&D losses, energy demand, per capita energy consumption) – energy pricing – Energy security
UNIT II  ENERGY AND ENVIRONMENT
9
Conventional Energy Sources - Emissions from fuels – Air, Water and Land pollution – Environmental standards - measurement and controls

UNIT III  SUSTAINABLE DEVELOPMENT
9

UNIT IV  RENEWABLE ENERGY TECHNOLOGY
9

UNIT V  ENERGY PLANNING FOR SUSTAINABLE DEVELOPMENT
9

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
1. Understand the world and Indian energy scenario
2. Analyse energy projects, its impact on environment and suggest control strategies
3. Recognise the need of Sustainable development and its impact on human resource development
4. Apply renewable energy technologies for sustainable development
5. Fathom Energy policies and planning for sustainable development.

REFERENCES:
7. https://www.niti.gov.in/verticals/energy

CES338  ENERGY EFFICIENCY FOR SUSTAINABLE DEVELOPMENT  LT PC
3 0 0 3

COURSE OBJECTIVES:
1. To understand the types of energy sources, energy efficiency and environmental implications of energy utilisation
2. To create awareness on energy audit and its impacts
3. To acquaint the techniques adopted for performance evaluation of thermal utilities
4. To familiarise on the procedures adopted for performance evaluation of electrical utilities
5. To learn the concept of sustainable development and the implication of energy usage

UNIT I ENERGY AND ENVIRONMENT
Primary energy sources - Coal, Oil, Gas – India Vs World with respect to energy production and consumption, Climate Change, Global Warming, Ozone Depletion, UNFCCC, COP

UNIT II ENERGY AUDITING
Need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments

UNIT III ENERGY EFFICIENCY IN THERMAL UTILITIES
Energy conservation avenues in steam generation and utilisation, furnaces, Thermic Fluid Heaters. Insulation and Refractories - Commercial waste heat recovery devices: recuperator, regenerator, heat pipe, heat exchangers (Plate, Shell & Tube), heat pumps, and thermocompression

UNIT IV ENERGY CONSERVATION IN ELECTRICAL UTILITIES
Demand side management - Power factor improvement – Energy efficient transformers - Energy conservation avenues in Motors, HVAC, fans, blowers, pumps, air compressors, illumination systems and cooling towers

UNIT V SUSTAINABLE DEVELOPMENT

TOTAL:45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to
1. Understand the prevailing energy scenario
2. Familiarise on energy audits and its relevance
3. Apply the concept of energy audit on thermal utilities
4. Employ relevant techniques for energy improvement in electrical utilities
5. Understand Sustainable development and its impact on human resource development

REFERENCES:
COURSE OBJECTIVES:
The objective of this course is to prepare the students to know about the general aspects of Electric and Hybrid Vehicles (EHV), including architectures, modelling, sizing, and sub system design and hybrid vehicle control.

UNIT I DESIGN CONSIDERATIONS FOR ELECTRIC VEHICLES

UNIT II ENERGY SOURCES

UNIT III MOTORS AND DRIVES
Types of Motors- DC motors- AC motors, PMSM motors, BLDC motors, Switched reluctance motors working principle, construction and characteristics.

UNIT IV POWER CONVERTERS AND CONTROLLERS
Solid state Switching elements and characteristics – BJT, MOSFET, IGBT, SCR and TRIAC - Power Converters – rectifiers, inverters and converters - Motor Drives - DC, AC motor, PMSM motors, BLDC motors, Switched reluctance motors – four quadrant operations –operating modes

UNIT V HYBRID AND ELECTRIC VEHICLES
Main components and working principles of a hybrid and electric vehicles, Different configurations of hybrid and electric vehicles. Power Split devices for Hybrid Vehicles - Operation modes - Control Strategies for Hybrid Vehicle - Economy of hybrid Vehicles - Case study on specification of electric and hybrid vehicles.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the student will be able to
1. Understand the operation and architecture of electric and hybrid vehicles
2. Identify various energy source options like battery and fuel cell
3. Select suitable electric motor for applications in hybrid and electric vehicles.
4. Explain the role of power electronics in hybrid and electric vehicles
5. Analyze the energy and design requirement for hybrid and electric vehicles.

TEXT BOOKS:

REFERENCES:

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>PSO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Avg.</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:
The objective of this course is to make the students to understand the working and characteristics of different types of batteries and their management.

UNIT I  ADVANCED BATTERIES  
Li-ion Batteries-different formats, chemistry, safe operating area, efficiency, aging. Characteristics-SOC,DOD, SOH. Balancing-Passive Balancing Vs Active Balancing. Other Batteries-NCM and NCA Batteries. NCR18650B specifications.

UNIT II  BATTERY PACK  
Battery Pack- design, sizing, calculations, flow chart, real and simulation Model.Peak power – definition, testing methods-relationships with Power, Temperature and ohmic Internal Resistance. Cloud based and Local Smart charging.

UNIT III  BATTERY MODELLING  
Battery Modelling Methods-Equivalent Circuit Models, Electrochemical Model, Neural Network Model. ECM Comparisons- Rint model, Thevenin model, PNGV model. State space Models-Introduction. Battery Modelling software/simulation frameworks

UNIT IV  BATTERY STATE ESTIMATION  

UNIT V  BMS ARCHITECTURE AND REAL TIME COMPONENTS  
Battery Management System- need, operation, classification. BMS ASIC-bq76PL536A-Q1 Battery Monitor IC- CC2662R-Q1 Wireless BMS MCU. Communication Modules- CAN Open-Flex Ray-CANedge1 package.ARBIN Battery Tester. BMS Development with Modeling software and Model-Based Design.

TOTAL =45 PERIODS

COURSE OUTCOMES:
At the end of this course, students will be able to
1. Acquire knowledge of different Li-ion Batteries performance.
2. Design a Battery Pack and make related calculations.
3. Demonstrate a Battery Model or Simulation.
5. Approach different BMS architectures during real world usage.

**TEXT BOOKS**

**REFERENCE BOOKS**
1. Developing Battery Management Systems with Simulink and Model-Based Design-whitepaper
2. Panasonic NCR18650B- DataSheet
3. bq76PL536A-Q1- IC DataSheet
4. CC2662R-Q1- IC DataSheet

---

**AU3008 SENSORS AND ACTUATORS**

**COURSE OBJECTIVES:**
- The objective of this course is to make the students to list common types of sensor and actuators used in automotive vehicles.

**UNIT I INTRODUCTION TO MEASUREMENTS AND SENSORS**
9

**UNIT II VARIABLE RESISTANCE AND INDUTANCE SENSORS**
9
Principle of operation- Construction details- Characteristics and applications of resistive potentiometer- Strain gauges- Resistive thermometers- Thermistors- Piezoresistive sensors Inductive potentiometer- Variable reluctance transducers: Ei pick up and LVDT

**UNIT III VARIABLE AND OTHER SPECIAL SENSORS**
9
Variable air gap type, variable area type and variable permittivity type- capacitor microphone Piezoelectric, Magnetostrictive, Hall Effect, semiconductor sensor- digital transducers-Humidity Sensor. Rain sensor, climatic condition sensor, solar, light sensor, antiglare sensor.

**UNIT IV AUTOMOTIVE ACTUATORS**
9

**UNIT V AUTOMATIC TEMPERATURE CONTROL ACTUATORS**
9
Different types of actuators used in automatic temperature control- Fixed and variable displacement temperature control- Semi Automatic- Controller design for Fixed and variable displacement type air conditioning system.

**TOTAL :45 PERIODS**

**COURSE OUTCOMES:**
At the end of the course, the student will be able to
1. List common types of sensor and actuators used in vehicles.
2. Design measuring equipment’s for the measurement of pressure force, temperature and flow.
3. Generate new ideas in designing the sensors and actuators for automotive application
4. Understand the operation of the sensors, actuators and electronic control.
5. Design temperature control actuators for vehicles.

TEXT BOOKS:

REFERENCES: