1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

   I. To impart knowledge to students in recent advances in the Computer Aided Manufacturing to educate them to prosper in Manufacturing engineering and research related professions.
   
   II. To enhance the scientific and engineering fundamentals the provide students with a solid foundation in required to solve analytical problems
   
   III. To coach students with good design and engineering skills so as to comprehend, analyze, design, and produce novel materials, products and solutions for the contemporary manufacturing issues.
   
   IV. To inculcate students with professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate Computer Integrated Manufacturing engineering issues to broader engineering and social context.

2. PROGRAMME OUTCOMES(POs):

<table>
<thead>
<tr>
<th>PO#</th>
<th>Programme Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>An ability to independently carry out research/investigation and development work to solve practical problems</td>
</tr>
<tr>
<td>2</td>
<td>An ability to write and present a substantial technical report/document</td>
</tr>
<tr>
<td>3</td>
<td>Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program</td>
</tr>
<tr>
<td>4</td>
<td>Graduate will demonstrate skills to use modern engineering tools, software and equipment to analyze engineering problems</td>
</tr>
<tr>
<td>5</td>
<td>Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks in the design and manufacturing applications</td>
</tr>
<tr>
<td>6</td>
<td>Responsibility of understanding ethically and professionally and develop confidence for self-education and ability for life-long learning</td>
</tr>
</tbody>
</table>

3. PEO/PO Mapping:

<table>
<thead>
<tr>
<th>PEO</th>
<th>PO</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>2</td>
</tr>
<tr>
<td>II.</td>
<td>2</td>
</tr>
<tr>
<td>III.</td>
<td>1</td>
</tr>
<tr>
<td>IV.</td>
<td>1</td>
</tr>
</tbody>
</table>

1,2,3,-, scale against the correlation PO’s with PEO’s
## PROGRAM ARTICULATION MATRIX OF M.E./M.TECH. CAD/CAM

<table>
<thead>
<tr>
<th></th>
<th>COURSE NAME</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>YEAR I</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SEMESTER I</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Computer Applications in Design</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Design for Sustainability</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Advanced Manufacturing Processes</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Computer Aided Tools for Manufacturing</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Professional Elective – I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Research Methodology and IPR</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Audit Course I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Computer Aided Design Laboratory</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Computer Aided Manufacturing Laboratory</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SEMESTER II</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Product Lifecycle Management</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Finite Element Methods in Mechanical Design</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Solid Freeform Manufacturing</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Industry 4.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Professional Elective-II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Professional Elective-III</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Audit Course II*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rapid Prototyping Laboratory</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Simulation and Analysis Laboratory</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>SEMESTER III</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Professional Elective-IV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Professional Elective-V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Open Elective</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technical Seminar</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>SEMESTER IV</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Project Work - I</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Project Work - II</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>YEAR II</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SEMESTER III</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Professional Elective-IV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Professional Elective-V</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Open Elective</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Technical Seminar</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>SEMESTER IV</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Project Work - I</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Project Work - II</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</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>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>-------------</td>
<td>--------------------------------------------</td>
<td>----------</td>
<td>-----------------</td>
<td>------------------------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Theory</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>ED4153</td>
<td>Computer Applications in Design</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>CD4152</td>
<td>Design for Sustainability</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>CC4101</td>
<td>Advanced Manufacturing Processes</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>CC4102</td>
<td>Computer Aided Tools for Manufacturing</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>RM4151</td>
<td>Research Methodology and IPR</td>
<td>RMC</td>
<td>2 0 0</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Professional Elective – I</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td>Audit Course I*</td>
<td>AC</td>
<td>2 0 0</td>
<td>2</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Practical</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>CD4161</td>
<td>Computer Aided Design Laboratory</td>
<td>PCC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>CM4161</td>
<td>Computer Aided Manufacturing Laboratory</td>
<td>PCC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>19 0 8</strong></td>
<td><strong>27</strong></td>
<td><strong>21</strong></td>
<td></td>
</tr>
</tbody>
</table>

* Audit Course is optional
<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Theory</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. PD4391 Product Lifecycle Management</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. ED4251 Finite Element Methods in Mechanical Design</td>
<td>PCC</td>
<td>3 1 0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. CM4152 Solid Freeform Manufacturing</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. I14091 Industry 4.0</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. Professional Elective-II</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>6. Professional Elective-III</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7. Audit Course II*</td>
<td>AC</td>
<td>2 0 0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PRACTICAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8. CC4211 Rapid Prototyping Laboratory</td>
<td>PCC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>9. ED4261 Simulation and Analysis Laboratory</td>
<td>PCC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TOTAL 20 1 8 29 23</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Audit Course is optional

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Theory</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. Professional Elective-IV</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Professional Elective-V</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Open Elective</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PRACTICAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. CC4311 Technical Seminar</td>
<td>EEG</td>
<td>0 0 2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. CC4312 Project Work I</td>
<td>EEG</td>
<td>0 0 12</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TOTAL 9 0 14 23 16</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>PRACTICAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>1. CC4411 Project Work II</td>
<td>EEC</td>
<td>0 0 24</td>
<td>24</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TOTAL 0 0 24 24 12</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 72
### PROFESSIONAL CORE COURSES (PCC)

<table>
<thead>
<tr>
<th>SL. NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>ED4153</td>
<td>Computer Applications in Design</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>CD4152</td>
<td>Design for Sustainability</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>CC4101</td>
<td>Advanced Manufacturing Processes</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>CC4102</td>
<td>Computer Aided Tools for Manufacturing</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>CD4161</td>
<td>Computer Aided Design Laboratory</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>6.</td>
<td>CM4161</td>
<td>Computer Aided Manufacturing Laboratory</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>7.</td>
<td>PD4391</td>
<td>Product Lifecycle Management</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8.</td>
<td>ED4251</td>
<td>Finite Element Methods in Mechanical Design</td>
<td>PCC</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>9.</td>
<td>CM4152</td>
<td>Solid Freeform Manufacturing</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10.</td>
<td>II4091</td>
<td>Industry 4.0</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11.</td>
<td>CC4211</td>
<td>Rapid Prototyping Laboratory</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>12.</td>
<td>ED4261</td>
<td>Simulation and Analysis Laboratory</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

### RESEARCH METHODOLOGY AND IPR COURSE (RMC)

<table>
<thead>
<tr>
<th>S. NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
<th>SEMESTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>RM4151</td>
<td>Research Methodology and IPR</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
### PROFESSIONAL ELECTIVES

#### SEMESTER I, ELECTIVE 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>PD4152</td>
<td>Integrated Product Development</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>ED4072</td>
<td>Composite Materials and Mechanics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CC4001</td>
<td>Computer Control in Process Planning</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

#### SEMESTER II, ELECTIVE 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>ED4091</td>
<td>Advanced Finite Element Analysis</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>ED4093</td>
<td>Optimization Techniques in Design</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CC4071</td>
<td>Advanced Machine tool Design</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>PD4153</td>
<td>Reverse Engineering</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

#### SEMESTER II, ELECTIVE 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>CC4002</td>
<td>Industrial Safety Management</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>ED4075</td>
<td>Mechanical Measurements and Analysis</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CC4003</td>
<td>Reliability in Engineering Systems</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
### SEMESTER III, ELECTIVES – IV

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>Periods Per Week</th>
<th>Total Contact Periods</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CC4004</td>
<td>Performance Modeling and Analysis of Manufacturing Systems</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>PD4151</td>
<td>Creativity and Innovation</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CD4092</td>
<td>Industrial Robotics and Expert systems</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CC4005</td>
<td>Design for Cellular Manufacturing Systems</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CM4072</td>
<td>Electronics Manufacturing Technology</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

### SEMESTER III, ELECTIVES – V

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>Periods Per Week</th>
<th>Total Contact Periods</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ED4079</td>
<td>Quality Concepts in Design</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>MF4092</td>
<td>Non-Destructive Testing</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>ED4071</td>
<td>Design of Hybrid and Electric Vehicles</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>ED4073</td>
<td>Material Handling Systems and Design</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>PD4291</td>
<td>Designing with Advanced Materials</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

### EMPLOYABILITY ENHANCEMENT COURSES (EEC)

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>CC4311</td>
<td>Technical Seminar</td>
<td>EEC</td>
<td>0 0 2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>CC4312</td>
<td>Project Work I</td>
<td>EEC</td>
<td>0 0 12</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>3.</td>
<td>CC4411</td>
<td>Project Work II</td>
<td>EEC</td>
<td>0 0 24</td>
<td>24</td>
<td>12</td>
</tr>
</tbody>
</table>
AUDIT COURSES (AC)
Registration for any of these courses is optional to students

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course Code</th>
<th>Course title</th>
<th>Periods Per week</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>AX4091</td>
<td>English for Research Paper Writing</td>
<td>2 0 0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>AX4092</td>
<td>Disaster Management</td>
<td>2 0 0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>AX4093</td>
<td>Constitution of India</td>
<td>2 0 0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>AX4094</td>
<td>நற்றமிழ் இலக்கியம்</td>
<td>2 0 0</td>
<td>0</td>
</tr>
</tbody>
</table>

LIST OF OPEN ELECTIVES FOR PG PROGRAMMES

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>OCE431</td>
<td>Integrated Water Resources Management</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>OCE432</td>
<td>Water, Sanitation and Health</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>OCE433</td>
<td>Principles of Sustainable Development</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>OCE434</td>
<td>Environmental Impact Assessment</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>OIC431</td>
<td>Blockchain Technologies</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>OIC432</td>
<td>Deep Learning</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>OBA431</td>
<td>Sustainable Management</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>OBA432</td>
<td>Micro and Small Business Management</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>OBA433</td>
<td>Intellectual Property Rights</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>OBA434</td>
<td>Ethical Management</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>ET4251</td>
<td>IoT for Smart Systems</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>ET4072</td>
<td>Machine Learning and Deep Learning</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>13.</td>
<td>PX4012</td>
<td>Renewable Energy Technology</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>14.</td>
<td>PS4093</td>
<td>Smart Grid</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>15.</td>
<td>CP4391</td>
<td>Security Practices</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>16.</td>
<td>MP4251</td>
<td>Cloud Computing Technologies</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>17.</td>
<td>IF4072</td>
<td>Design Thinking</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>18.</td>
<td>MU4153</td>
<td>Principles of Multimedia</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>19.</td>
<td>DS4015</td>
<td>Big Data Analytics</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>20.</td>
<td>NC4201</td>
<td>Internet of Things and Cloud</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>21.</td>
<td>MX4073</td>
<td>Medical Robotics</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>22.</td>
<td>VE4202</td>
<td>Embedded Automation</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>23.</td>
<td>CX4016</td>
<td>Environmental Sustainability</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>24.</td>
<td>TX4092</td>
<td>Textile Reinforced Composites</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>25.</td>
<td>NT4002</td>
<td>Nanocomposite Materials</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>26.</td>
<td>BY4016</td>
<td>IPR, Biosafety and Entrepreneurship</td>
<td>3 0 0</td>
<td>3</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:

- To understand fundamental concepts of computer graphics and its tools in a generic framework.
- To impart the parametric fundamentals to create and manipulate geometric models using curves, surfaces and solids.
- To impart the parametric fundamentals to create and manipulate geometric models using NURBS and solids.
- To provide clear understanding of CAD systems for 3D modeling and viewing.
- To create strong skills of assembly modeling and prepare the student to be an effective user of a standards in CAD system.

UNIT – I INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS


Geometric Transformations: Coordinate Transformations, Windowing and Clipping, 2D Geometric transformations-Translation, Scaling, Shearing, Rotation and Reflection, Composite transformation, 3D transformations.

UNIT – II CURVES AND SURFACES MODELLING

Introduction to curves - Analytical curves: line, circle and conics – synthetic curves: Hermite cubic spline- Bezier curve and B-Spline curve – curve manipulations.


UNIT – III NURBS AND SOLID MODELING


UNIT – IV VISUAL REALISM


Animation - Conventional, Computer animation, Engineering animation - types and techniques.

UNIT – V ASSEMBLY OF PARTS AND PRODUCT LIFE CYCLE MANAGEMENT


TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Solve 2D and 3D transformations for the basic entities like line and circle.
2. Formulate the basic mathematics fundamental to CAD system.
3. Use the different geometric modeling techniques like feature based modeling, surface modeling and solid modeling.
4. Create geometric models through animation and transform them into real world systems.

REFERENCES:

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

CD4152 DESIGN FOR SUSTAINABILITY

COURSE OBJECTIVES
1. Selecting the relevant process; applying the general design principles for manufacturability; GD &T.
2. Applying the design considerations while designing the cast and welded components.
3. Applying the design considerations while designing the formed and machined components.
4. Apply design considerations for assembled systems.
5. Apply design considerations for environmental issues.
UNIT-I   INTRODUCTION
Introduction - Economics of process selection - General design principles for manufacturability; Geometric Dimensioning & Tolerance (GD&T) - Form tolerancing: straightness, flatness, circularity, cylindricity - Profile tolerancing: profile of a line, and surface - Orientation tolerancing: angularity, perpendicularity, parallelism - Location tolerancing: position, concentricity, symmetry - run out tolerancing: circular and total-Supplementary symbols.

UNIT-II   CAST & WELDED COMPONENTS DESIGN

UNIT-III   FORMED & MACHINED COMPONENTS DESIGN
Design considerations for: Metal extruded parts - Impact/Cold extruded parts - Stamped parts - Forged parts. Design considerations for: Turned parts- Drilled parts - Milled, planned, shaped and slotted parts-Ground parts.

UNIT-IV   DESIGN FOR ASSEMBLY
Design for assembly - General assembly recommendations - Minimizing the no. of parts - Design considerations for: Rivets - Screw fasteners - Gasket & Seals - Press fits - Snap fits - Automatic assembly- Computer Application for DFMA.

UNIT-V   DESIGN FOR ENVIRONMENT

TOTAL = 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Select relevant process; apply the general design principles for manufacturability; GD&T.
2. Apply design considerations while designing the cast and welded components.
3. Apply design considerations while designing the formed and machined components.
4. Apply design considerations for assembled systems.
5. Apply design considerations for environmental issues.

REFERENCES:
2. Bralla, Design for Manufacture handbook, McGrawhill,1999
### CC4101 ADVANCED MANUFACTURING PROCESSES

<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>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>AVg.</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

### COURSE OBJECTIVES:
1. To analyze and determine material fabrication processes.
2. To use laboratory instrument doing routine metrological measurements.
3. To operate regular machine shop equipment such as grinders, drill presses, lathes, milling machines, shapers and etc.
4. To recognize engine machine tool requirements and be selective in the choice of tools.
5. To setup and operate machines, index and determine machine speeds, feeds, and depth of cut requirements.
6. To identify with numerical control machining and computer programming.

### UNIT–I SURFACE TREATMENT
Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapour deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.

### UNIT–II NON-TRADITIONAL MACHINING

### UNIT–III LASER BEAM MACHINING
UNIT– IV PROCESSING OF CERAMICS

UNIT– V FABRICATION OF MICROELECTRONIC DEVICES
Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in microelectronics, surface mount technology, Integrated circuit economics. E-Manufacturing, nanotechnology, and micromachining, High speed Machining

TOTAL: 45 PERIODS

COURSE OUTCOMES:
• At the end of the course, the student will be able to understand the working principle of Electron beam, laser beam and laser hybrid welding processes.
• Able to understand different types of composite material characteristics, types of micro & macro machining processes.
• Understand the e-manufacturing & nano materials
• To make the students get acquainted with the design for manufacturing, assembly and environment.

REFERENCES:

Mapping of CO with PO and PSO

<table>
<thead>
<tr>
<th></th>
<th>PO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>CO1</td>
<td>2 2 2 3</td>
</tr>
<tr>
<td>CO2</td>
<td>2 2</td>
</tr>
<tr>
<td>CO3</td>
<td>2 2 2 2 3</td>
</tr>
<tr>
<td>CO4</td>
<td>3 2 2 2 3</td>
</tr>
<tr>
<td>AVG</td>
<td>3 3 3 3 2 3</td>
</tr>
</tbody>
</table>

1-low, 2-medium, 3-high, *-* no correlation
COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for computer aided tools that can be implemented in various industrial applications.

UNIT– I COMPUTER AIDED MANUFACTURING

UNIT– II COMPUTER AIDED PROCESS PLANNING

UNIT–III COMPUTER AIDED INSPECTION

UNIT– IV REVERSE ENGINEERING

UNIT– V DATA MANAGEMENT

REFERENCES:

TOTAL:45 PERIODS
Mapping of CO with PO and PSO

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVG</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

RM4151 RESEARCH METHODOLOGY AND IPR L T P C 2 0 0 2

UNIT I RESEARCH DESIGN 6
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II DATA COLLECTION AND SOURCES 6
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING 6
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV INTELLECTUAL PROPERTY RIGHTS 6

UNIT V PATENTS 6

TOTAL : 30 PERIODS

REFERENCES
COURSE OBJECTIVES:
- To impart knowledge on how to prepare drawings for various mechanical components using any commercially available 3D modeling software's
- CAD Introduction.
- Sketcher
- Solid modeling - Extrude, Revolve, Sweep and variational sweep, Loft
- Surface modeling - Extrude, Sweep, Trim and Mesh of curves, Freeform.
- Feature manipulation - Copy, Edit, Pattern, Suppress, History operations etc.
- Assembly - Constraints, Exploded Views, Interference check

Exercises in modeling and drafting of mechanical components-assembly using parametric and feature-based packages like PRO-E/SOLIDWORKS /CATIA/NX

TOTAL= 60 PERIODS

OUTCOMES:
On completion of the course the student will be able to
- Use the modern engineering tools necessary for engineering practice
- Draw 2D part drawings, sectional views, and assembly drawings as per standards.
- Create 3D Model on any CAD software.
- Convert 3D solid models into 2D drawings and prepare different views, sections, and dimensioning of part models.
- Examine interference to ensure that parts will not interfere.

Mapping of CO with PO

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>AVg.</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:

- To familiarize students with manual CNC part programming for milling and turning machines.
- To generate part programs using CAM packages for milling and turning machines.
- To train students with dimensional and geometric measurements for machined features using video measuring system and coordinate measuring machine.
- To get hands on knowledge on programming logic controller - ladder programming and robot programming.
- To introduce the concept of printing parts using additive manufacturing and to introduce Relational database management system in Material requirements planning.

LIST OF EXPERIMENTS

1. Programming and simulation for various operations using canned cycle for CNC turning Centre.
2. Programming and simulation for machining of internal surfaces in CNC turning Centre
3. Programming and simulation for profile milling operations
4. Programming and simulation for circular and rectangular pocket milling
5. Programming and simulation using canned cycle for CNC Milling such as peck drilling and tapping cycle
6. CNC code generation using CAM software packages – Milling
7. CNC code generation using CAM software packages – Turning
8. Dimensional and geometric measurement of machined features using VMS and CMM
9. PLC ladder logic programming.
10. Robot programming for Material handling applications.
11. Study on RDBMS and its application in problems like inventory control MRP.
12. Design and fabrication of a component using extrusion based additive manufacturing.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, the students shall be able to:

CO1: Explain the manual CNC part programming for milling and turning machines.
CO2: Create part programs using CAM packages for milling and turning Machines.
CO3: Appraise dimensional and geometric measurements of machined features using video measuring system and coordinate measuring machine.
CO4: Construct PLC ladder programming and robot programming.
CO5: Relate the concept of printing parts using additive manufacturing and appreciate the application RDBMS in MRP.

LIST OF EQUIPMENTS REQUIRED:

1. Computers 30
2. CAM Software for 3 axis machining or more
3. CNC Production type turning or Machining center
4. Video Measuring System
5. Coordinate Measuring Machine
6. Surface Roughness tester
7. 5-axis Robot
8. Programmable Logic Controller with ladder logic programming software
9. RDMBS Package with relevant modules like Inventory Control and MRP
10. 3D Printer
**OBJECTIVES:**
1. To understand history, concepts and terminology of PLM
2. To understand functions and features of PLM/PDM
3. To understand different modules offered in commercial PLM/PDM tools
4. To demonstrate PLM/PDM approaches for industrial applications
5. To Use PLM/PDM with legacy data bases, CAX & ERP systems

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

**UNIT II  PLM/PDM FUNCTIONS AND FEATURES**

**UNIT III  DETAILS OF MODULES IN APDM/PLM SOFTWARE**
Case studies based on top few commercial PLM/PDM tools

**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, organization, users, product or service, process performance.
UNIT V   BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE
PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP
TOTAL: 45 PERIODS

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

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Avg</td>
<td>1.4</td>
</tr>
</tbody>
</table>

01 Low 02 Medium 03 High

REFERENCES
# COURSE OBJECTIVES

1. To learn mathematical models for one dimensional problems and their numerical solutions
2. To learn two dimensional scalar and vector variable problems to determine field variables
3. To learn Iso parametric transformation and numerical integration for evaluation of element matrices
4. To study various solution techniques to solve Eigen value problems
5. To learn solution techniques to solve non-linear problems

## UNIT-I  
### FINITE ELEMENT ANALYSIS OF ONE DIMENSIONAL PROBLEMS


## UNIT-II  
### FINITE ELEMENT ANALYSIS OF TWO DIMENSIONAL PROBLEMS


## UNIT-III  
### ISO-PARAMETRIC FORMULATION

Natural Co-ordinate Systems – Lagrangian Interpolation Polynomials – Iso parametric Elements – Formulation – Shape functions -one dimensional , two dimensional triangular and quadrilateral elements - Serendipity elements- Jacobian transformation - Numerical Integration – Gauss quadrature – one, two and three point integration

## UNIT-IV  
### EIGEN VALUE PROBLEMS

Dynamic Analysis – Equations of Motion – Consistent and lumped mass matrices – Free Vibration analysis – Natural frequencies of Longitudinal, Transverse and torsional vibration – Solution of Eigenvalue problems - Introduction to transient field problems

## UNIT-V  
### NON-LINEAR ANALYSIS

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

**TOTAL = 60 PERIODS**
COURSE OUTCOMES:
On Completion of the course the student will be able to
- Develop mathematical models for one dimensional problems and their numerical solutions
- Determine field variables for two dimensional scalar and vector variable problems
- Apply Isoparametric transformation and numerical integration for evaluation of element matrices
- Apply various solution techniques to solve Eigen value problems
- Formulate solution techniques to solve non-linear problems

REFERENCES:

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

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

CM4152 SOLID FREEFORM MANUFACTURING L T P C
3 0 0 3

COURSE OBJECTIVES:
- To acquaint the students with evolution of Solid Freeform Manufacturing (SFM) / Additive Manufacturing (AM), proliferation into various fields and its effects on supply chain.
- To gain knowledge on Design for Additive Manufacturing (DFAM) and its importance in quality improvement of fabricated parts.
- To acquaint with polymerization and sheet lamination processes and their applications.
- To acquaint with material extrusion and powder bed fusion processes.
- To gain knowledge on jetting and direct energy deposition processes and their applications.
UNIT I  INTRODUCTION  9

UNIT II  DESIGN FOR ADDITIVE MANUFACTURING  9

UNIT III  VAT POLYMERIZATION AND SHEET LAMINATION PROCESSES  9

UNIT IV  MATERIAL EXTRUSION AND POWDER BED FUSION PROCESSES  9

UNIT V  JETTING AND DIRECT ENERGY DEPOSITION PROCESSES  9

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

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Avg</td>
<td>(14/5)=2.8</td>
<td>(14/5)=2.8</td>
<td>(10/5)=2</td>
<td>(15/5)=3</td>
<td>(10/4)=2.5</td>
<td>(7/5)=1.4</td>
</tr>
</tbody>
</table>

II4091

OBJECTIVES:
The students will be able to
- Understand Industry 4.0
- Apply IoT and IIoT for Industry 4.0
- Understand CPS for Industry 4.0

UNIT I
Introduction to Industry 4.0 The Various Industrial Revolutions - Digitalisation and the Networked Economy - Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0 - Comparison of Industry 4.0 Factory and Today's Factory - Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation

UNIT II
Road to Industry 4.0 - Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services - Smart Manufacturing - Smart Devices and Products - Smart Logistics - Smart Cities - Predictive Analytics
UNIT III

UNIT IV
Role of data, information, knowledge and collaboration in future organizations - Resource- based view of a firm - Data as a new resource for organizations - Harnessing and sharing knowledge in organizations - Cloud Computing Basics - Cloud Computing and Industry 4.0

UNIT V
Industry 4.0 IIoT case studies - Opportunities and Challenges - Future of Works and Skills for Workers in the Industry 4.0 Era - Strategies for competing in an Industry 4.0 world – Society 5.0

TOTAL: 45 PERIODS

OUTCOMES:
The students will be able to
- Use Industry 4.0 for Industrial Applications
- Use IoT and IIoT for Industry 4.0
- Apply smart devices Industrial Applications

TEXT BOOKS
1. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things

CC4211 RAPID PROTOTYPING LABORATORY L T P C
0 0 4 2

COURSE OUTCOMES:
At the end of the course, the student shall be able to:
1. Optimize the process parameters of FDM machine to improve the quality of the parts produced.
2. Build complex engineering assemblies in plastic material with less process planning.
3. Improve surface finish of fabricated plastic components for the engineering applications.
4. Design and fabricate working models for the conceptual testing applications.

DETAILED SYLLABUS:
1. Review of CAD Modeling Techniques and Introduction to RP
2. Forming Groups & Assigning Creative Idea
3. Generating STL files from the CAD Models & Working on STL files
4. Modeling Creative Designs in CAD Software
5. Assembling Creative Designs in CAD Software
6. Processing the CAD data in Catalyst software (Selection of Orientation, Supports generation, Slicing, Tool path generation)
7. Sending the tool path data to FDM RP machine
8. Removing the supports & post processing (cleaning the surfaces)
9. Demonstrating Creative Working Models
Mapping of CO with PO

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>AVg.</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

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

ED4261 SIMULATION AND ANALYSIS LABORATORY

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

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

TOTAL: 60 PERIODS

LIST OF EQUIPMENTS / SOFTWARE:
Finite Element Analysis packages

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1 Solve engineering problems numerically using Computer Aided Finite Element Analysis packages
CO2 Analyze the force, stress, deflection in mechanical components.
CO3 Analyze thermal stress and heat transfer in mechanical components.
CO4 Analyze the vibration of mechanical components.
CO5 Analyze the modal, harmonic, transient and spectrum concepts in mechanical components.
COURSE OBJECTIVES:
- To work on a specific technical topic in Engineering design related topics in order to acquire the skills of oral presentation.
- To acquire technical writing abilities for seminars and conferences.

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

TOTAL: 30 PERIODS

COURSE OUTCOMES:
On completion of the course the student will be able to:

**CO1:** Students comprehend concepts and methods adequate to understand inductive and deductive reasoning, and increase their general problem solving skills.

**CO2:** Students develop communicative skills (e.g. speaking, listening, reading, and/or writing).

**Mapping of CO with PO**

<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>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td></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></td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>AVg.</td>
<td></td>
<td>3</td>
<td>3</td>
<td>2.2</td>
<td>2.8</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

1-low, 2-medium, 3-high, ‘-’- no correlation
**COURSE OBJECTIVES**
1. To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
2. To develop the methodology to solve the identified problem.
3. To train the students in preparing project reports and to face reviews and viva-voce examination.

**SYLLABUS:**
The student individually works on a specific topic approved by the head of the division under the guidance of a faculty member who is familiar in this area of interest. The student can select any topic which is relevant to the area of engineering design and manufacturing applications. The topic may be theoretical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

**COURSE OUTCOMES:**
On completion of the course the student will be able to:
CO1 Demonstrate a sound technical knowledge of their selected project topic.
CO2 Undertake problem identification, formulation and solution.
CO3 Design and manufacturing engineering solutions to complex problems utilising a systems approach.
CO4 The students will have a clear idea of their area of work and they will be in a position to carry out the remaining phase II work in a systematic way.

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Avg.</td>
<td>2</td>
</tr>
</tbody>
</table>

**TOTAL: 360 PERIODS**
OUTCOME:
On completion of the project work students will be in a position to take up any challenging practical problem in the field of engineering design and find better solutions to it.

COURSE OUTCOMES:
On Completion of the course the student will be able to
CO1 Demonstrate a sound technical knowledge of their selected project topic.
CO2 Undertake problem identification, formulation and solution.
CO3 Design engineering solutions to complex problems utilising a systems approach
CO4 Demonstrate the knowledge, skills and attitudes of a professional engineer to take up any challenging practical problem in the field of engineering design and manufacturing engineering and find better solutions to it.

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

PD4152 INTEGRATED PRODUCT DEVELOPMENT

COURSE OBJECTIVES:
1. To Understand the principles of generic development process; product planning; customer need analysis for new product design and development.
2. To enhance the understanding of setting product specifications and generate, select, screen, and test concepts for new product design and development.
3. To apply the principles of product architecture and the importance of industrial design principles and DFM principles for new product development.
4. To expose the different Prototyping techniques, Design of Experiment principles to develop a robust design and importance to patent a developed new product.
5. Applying the concepts of economics principles; project management practices in development of new product.

UNIT– I INTRODUCTION TO PRODUCT DESIGN

UNIT– II PRODUCT SPECIFICATIONS, CONCEPT GENERATION, SELECTION AND TESTING
Establish Target and Final product specifications – Activities of Concept Generation - Concept Screening and Scoring - Concept Testing Methodologies.
UNIT–III  PRODUCT ARCHITECTURE AND INDUSTRIAL DESIGN  9
Product Architecture – Implications and establishing the architecture – Delayed Differentiation – Platform Planning – Related system level design issues - Need and impact of industrial design - Industrial design process - management of the industrial design process - assessing the quality of industrial design

UNIT– IV  DESIGN FOR MANUFACTURE, PROTOTYPING AND ROBUST DESIGN  9
DFM Definition - Estimation of Manufacturing cost- Reducing the component costs, costs of supporting function and assembly costs – Impact of DFM decision on other factors - Prototype basics - Principles of prototyping – Prototyping technologies - Planning for prototypes - Robust design –Robust Design Process

UNIT– V  PRODUCT DEVELOPMENT ECONOMICS AND MANAGING PROJECTS  9
Economic Analysis – Elements of Economic Analysis - Understanding and representing tasks- Baseline Project Planning - Accelerating the project - Project execution – Postmortem project evaluation.

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Apply the principles of generic development process; product planning; customer need analysis for new product design and development.
2. Set product specifications and generate, select, screen, test concepts for new product design and development.
3. Apply the principles of product architecture, industrial design and design for manufacturing principles in new product development.
4. Apply the adopt Prototyping techniques and Design of Experiment principles to develop a robust design and document a new product for patent.

REFERENCES:
ED4072 COMPOSITE MATERIALS AND MECHANICS

COURSE OBJECTIVES:
1. Study of different composite materials and finding its mechanical strength
2. Fabrication of FRP and other composites by different manufacturing methods
3. Stress analysis of fiber reinforced Laminates for different combinations of plies with different orientations of the fiber.
4. Calculation of stresses in the lamina of the laminate using different failure theories
5. Calculation of residual stresses in different types of laminates under thermo-mechanical load using the Classical Laminate Theory.

UNIT-I INTRODUCTION TO COMPOSITE MATERIALS

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

UNIT-III LAMINA CONSTITUTIVE EQUATIONS
UNIT-IV  LAMINA STRENGTH ANALYSIS AND ANALYSIS OF LAMINATED FLAT PLATES


UNIT- V  THERMO-STRUCTURAL ANALYSIS


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

TOTAL(L:45)=45 PERIODS

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

REFERENCES:

<table>
<thead>
<tr>
<th></th>
<th>CO</th>
<th>PO</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>AVg.</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
CC4001 COMPUTER CONTROL IN PROCESS PLANNING

COURSE OBJECTIVES:
- To provide the student with an understanding of the importance of process planning role in manufacturing and the application of Computer Aided Process Planning tool in the present manufacturing scenario.

UNIT I INTRODUCTION
The Place of Process Planning in the Manufacturing cycle - Process Planning and Production Planning – Process Planning and Concurrent Engineering, CAPP, Group Technology

UNIT II PART DESIGN REPRESENTATION

UNIT III PROCESS ENGINEERING AND PROCESS PLANNING
Experienced, based planning - Decision table and decision trees - Process capability analysis - Process Planning - Variant process planning - Generative approach - Forward and Backward planning, Input format, AI.

UNIT IV COMPUTER AIDED PROCESS PLANNING SYSTEMS
Logical Design of a Process Planning - Implementation considerations -manufacturing system components, production Volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP.

UNIT V AN INTERGRADED PROCESS PLANNING SYSTEMS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- To understand the need of process planning in manufacturing
- To know handle the computer aided process planning tool
- To apply the knowledge of Expert systems, Group technology and part representation for various applications
- To interpret the use of computer aided process panning for CAD/CAM Systems
- To analyse the computer aided planning systems for various industrial applications

REFERENCES:
WEB REFERENCES:

Mapping of CO with PO

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>AVg.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

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

COURSE OBJECTIVES
1. To study concept of Finite Element Analysis to solve problems involving plate and shell elements
2. To learn concept of Finite Element Analysis to solve problems involving geometric and material non linearity
3. To study solution techniques to solve dynamic problems
4. To study the concepts of Finite Element Analysis to solve fluid mechanics and heat transfer problems
5. To study error norms, convergence rates and refinement.

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

UNIT-II NON-LINEAR PROBLEMS

UNIT-III DYNAMIC PROBLEM
UNIT-IV  FLUID MECHANICS AND HEAT TRANSFER  
Governing Equations of Fluid Mechanics – Solid structure interaction - Inviscid and 
Incompressible Flow – Potential Formulations – Slow Non-Newtonian Flow – Metal and Polymer 
Forming–Navier Stokes Equation–Steady and Transient Solution.

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

TOTAL= 45 PERIODS

COURSE OUTCOMES:
On Completion of the course the student will be able to
  CO1 Apply concept of Finite Element Analysis to solve problems involving plate and shell elements
  CO2 Apply concept of Finite Element Analysis to solve problems involving geometric and material non linearity
  CO3 Formulate solution techniques to solve dynamic problems
  CO4 Apply concepts of Finite Element Analysis to solve fluid mechanics and heat transfer problems
  CO5 Investigate error norms, convergence rates and refinement.

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

1-low, 2-medium, 3-high, '---' no correlation
ED4093 OPTIMIZATION TECHNIQUES IN DESIGN L T P C
3 0 0 3

COURSE OBJECTIVES:
1. To understand the basic concepts of unconstrained optimization techniques.
2. To understand the basic concepts of constrained optimization techniques.
3. To provide the mathematical foundation of artificial neural networks and swarm intelligence for design problems.
4. To implement optimization approaches and to select appropriate solutions for design applications.
5. To demonstrate selected optimization algorithms commonly used in static and dynamic applications.

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

UNIT–II CONSTRAINED OPTIMIZATION TECHNIQUES

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

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

UNIT–V STATIC AND DYNAMIC APPLICATIONS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1 Formulate unconstrained optimization techniques in engineering design application.
CO2 Formulate constrained optimization techniques for various applications.
CO3 Implement neural network technique to real world design problems.
CO4 Apply genetic algorithms to combinatorial optimization problems.
CO5 Evaluate solutions by various optimization approaches for a design problem.

TOTAL: 45 PERIODS
REFERENCES:

<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>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>AVg.</td>
<td></td>
<td>3</td>
<td>2.6</td>
<td>2.6</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

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

CC4071 ADVANCED MACHINE TOOL DESIGN L T P C 3 0 0 3

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

UNIT I INTRODUCTION TO MACHINE TOOL DESIGN 9

UNIT II REGULATION OF SPEEDS AND FEEDS 9
Aim of Speed and Feed Regulation, Stepped Regulation of Speeds, Multiple Speed Motors, Ray Diagrams and Design Considerations, Design of Speed Gear Boxes, Feed Drives, Feed Box Design

UNIT III DESIGN OF MACHINE TOOL STRUCTURES 9
UNIT IV DESIGN OF GUIDEWAYS AND POWER SCREWS


UNIT V DESIGN OF SPINDLES AND SPINDLE SUPPORT


TOTAL = 45 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
1. Select the different machine tool mechanisms.
2. Design the Multi speed Gear Box and feed drives.
3. Design the machine tool structures.
4. Design the guideways and power screws.
5. Design the spindles and bearings.

REFERENCES:
COURSE OBJECTIVES:
1. Applying the fundamental concepts and principles of reverse engineering in product design and development.
2. Applying the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
3. Applying the concept and principles of material identification and process verification in reverse engineering of product design and development.
4. Applying the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.
5. Analyzing the various legal aspect and applications of reverse engineering in product design and development.

UNIT I INTRODUCTION TO REVERSE ENGINEERING & GEOMETRIC FORM

UNIT II MATERIAL CHARACTERISTICS, PART DURABILITY AND LIFE LIMITATION
Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness – Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure

UNIT III MATERIAL IDENTIFICATION AND PROCESS VERIFICATION

UNIT IV DATA PROCESSING, PART PERFORMANCE AND SYSTEM COMPATIBILITY

UNIT V ACCEPTANCE, LEGALITY AND INDUSTRIAL APPLICATIONS OF RE

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
1. Apply the fundamental concepts and principles of reverse engineering in product design and development.
2. Apply the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
3. Apply the concept and principles of material identification and process verification in reverse engineering of product design and development.
4. Apply the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.
5. Analyze the various legal aspect and applications of reverse engineering in product design and development.
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>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>AVg.</td>
<td>2.6</td>
<td>2.6</td>
<td>1</td>
<td>1.6</td>
<td>-</td>
<td>1</td>
</tr>
</tbody>
</table>

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

CC4002 INDUSTRIAL SAFETY MANAGEMENT

COURSE OBJECTIVES:
1. To achieve an understanding of principles of safety management.
2. To enable the students to learn about various functions and activities of safety department.
3. To have knowledge about sources of information for safety promotion and training.
4. To familiarize students with evaluation of safety performance.

UNIT– I SAFETY MANAGEMENT

UNIT– II OPERATIONAL SAFETY

UNIT–III SAFETY MEASURES
Layout design and material handling – Use of electricity – Management of toxic gases and chemicals - Industrial fires and prevention - Road safety - highway and urban safety - Safety of sewage disposal and cleaning - Control of environmental pollution - Managing emergencies in Industries-planning, security and risk assessments, on-site and offsite. Control of major industrial hazards.
UNIT– IV ACCIDENT PREVENTION

Human side of safety - personal protective equipment - Causes and cost of accidents. Accident prevention programmes - Specific hazard control strategies - HAZOP - Training and development of employees - First Aid - Fire fighting devices - Accident reporting, investigation.

UNIT– V SAFETY, HEALTH, WELFARE & LAWS


TOTAL: 45 PERIODS

COURSE OUTCOMES:

- To understand the functions and activities of safety engineering department.
- To carry out a safety audit and prepare a report for the audit.
- To prepare an accident investigation report.
- To estimate the accident cost using supervisors report and data.
- To evaluate the safety performance of an organization from accident records.
- To identify various agencies, support institutions and government organizations involved in safety training and promotion.

REFERENCES:


Mapping of CO with PO

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>AVg.</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:
1. The student will understand the principle of force and strain measurement.
2. The student will understand the vibration measurement and their applications.
3. To impart knowledge on the principle behind acoustics and wind flow measurements.
4. To familiarize with the distress measurements
5. To realize the non destructive testing principle and application

UNIT– I FORCES AND STRAIN MEASUREMENT

UNIT– II VIBRATION MEASUREMENTS

UNIT–III ACOUSTICS AND WIND FLOW MEASUREMENTS

UNIT– IV DISTRESS MEASUREMENTS

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

COURSEOUTCOMES:
Upon completion of this course the students will be able to:
CO1 Measure physical quantities such as forces and strains.
CO2 Apply different vibration measurements techniques.
CO3 Measure physical quantities such as pressure and flow.
CO4 Apply techniques involved in crack measurement.
CO5 Select the appropriate nondestructive testing methods for various engineering applications.
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>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>AVg.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

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

RELIABILITY IN ENGINEERING SYSTEMS

<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. The ability to use statistical tools to characterize the reliability of an item;
2. The working knowledge to determine the reliability of a system a
3. To suggest approaches to enhancing system reliability;
4. The ability to select appropriate reliability validation methods

UNIT– I RELIABILITY CONCEPT

UNIT– II FAILURE DATA ANALYSIS

UNIT–III RELIABILITYASSESSMENT
UNIT– IV  RELIABILITY MONITORING

UNIT– V  RELIABILITY IMPROVEMENT

TOTAL: 45 PERIODS

COURSE OUTCOMES:
• Analyse the interference between strength and stress, or life data for estimating reliability;
• Apply the appropriate methodologies and tools for enhancing the inherent and actual reliability of components and systems, taking into consideration cost aspects; specify life test plans for reliability validation

REFERENCES:

Mapping of CO with PO

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>AVG</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

1-low, 2-medium, 3-high, - - no correlation
COURSE OBJECTIVES:
1. To develop an understanding of the use and benefits of modeling and simulation in manufacturing systems design and operation.
2. To develop an understanding of techniques to assess factory performance and identify areas for improvement.
3. To develop an understanding of techniques to assess and manufacturing performance.
4. To develop an understanding of techniques to enable responsive manufacturing systems.
5. To provide the students with knowledge of a set of tools to enable them to assess the performance of a manufacturing facility.

UNIT – I MANUFACTURING SYSTEMS & CONTROL

UNIT – II MANUFACTURING PROCESSES

UNIT – III QUEUING MODELS
Notation for queues - Examples of queues in manufacturing systems - Performance measures - Little’s result-Steady state analysis of M/M/m queue, queues with general distributions and queues with breakdowns-Analysis of a flexible machine center.

UNIT – IV QUEUING NETWORKS

UNIT – V PETRINETS

TOTAL: 45 PERIODS
COURSE OUTCOMES:
1. Model and simulate the operation of a small manufacturing system.
2. Use simulation as a manufacturing system design technique.
3. Justify the use of manufacturing modeling and simulation.
4. Use techniques such as value stream mapping and IDEF to identify improvements required in a manufacturing system.

REFERENCES:

Mapping of CO with PO

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>AVg.</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

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

PD4151 CREATIVITY AND INNOVATION L T P C
3 0 0 3

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

UNIT I INTRODUCTION TO ESSENTIAL THEORY OF CREATIVITY 9

UNIT II METHODS AND TOOLS FOR CREATIVITY 9
Three basic principles behind the tools of directed creativity – Tools that prepare the mind for creative thought – Tools that stimulate the imagination for new idea – Development and action: the bridge between mere creativity and the rewards of innovation - ICEDIP: Inspiration, Clarification, Distillation, Perspiration, Evaluation and Incubation – Creativity and Motivation.
UNIT III DESIGN AND APPLICATION OF CREATIVITY
Three levels of emotional design: Visceral, Behavioral and Reflective – Process design, reengineering, and creativity – Creativity and customer needs analysis – Innovative product and service design – Creative problem solving and incremental improvement.

UNIT IV INNOVATION PRINCIPLES & PRACTICES
Methods of Creativity Activation: Morphological Box – Requirements for Inventive Problem Solving – Altshuller’s Engineering Parameters– Altshuller’s Inventive Principles– Altshuller’s Contradiction Matrix Algorithm.

UNIT V INNOVATION MANAGEMENT

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
1. Apply the principles of essential theory of creativity in new product design and development.
2. Apply the principles of various methods and tools for creativity in new product design and development.
3. Apply the design principles of creativity in new product design and development.
4. Apply the various innovation principles and practices in new product design and development.
5. Apply the principles of innovation management in new product design and development

REFERENCES
3. Geoffrey Petty,” how to be better at Creativity”, The Industrial Society 1999

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
<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>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>AVg.</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

1-low, 2-medium, 3-high, -“- no correlation
OBJECTIVES:
- To appreciate the need and scope for robotics and to understand the principles of robot kinematics
- To design the drive systems and its control
- To understand the principles of sensors and vision systems
- To envision the industrial applications of robots and its safety
- To gain knowledge on artificial intelligence and expert systems.

UNIT I  INTRODUCTION AND ROBOT KINEMATICS  9

UNIT II  ROBOT DRIVES AND CONTROL  9

UNIT III  ROBOT SENSORS  9

UNIT IV  ROBOT CELL DESIGN AND APPLICATION  9

UNIT V  ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS  9

TOTAL : 45 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
- Understand robot kinematics
- Incorporate mechanical components and concepts in robotics
- Understand the basics of various sensors to effectively design a robot
- Design suitable robots for specific applications
- Optimize the robots using Artificial Intelligence
REFERENCES

Mapping of CO with PO

<table>
<thead>
<tr>
<th>CO</th>
<th>PO 1</th>
<th>PO 2</th>
<th>PO 3</th>
<th>PO 4</th>
<th>PO 5</th>
<th>PO 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>AVg.</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

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

CC4005 DESIGN FOR CELLULAR MANUFACTURING SYSTEMS

COURSE OBJECTIVES:
1. At the end of this course the student should be able to understand
2. Concepts and applications of Cellular manufacturing systems
3. Traditional and non-traditional approaches of Problem solving Performance measurement
4. Human and economical aspects of CMS.

UNIT–I INTRODUCTION
Introduction to Group Technology, Limitations of traditional manufacturing systems, characteristics and design of groups, benefits of GT and issues in GT.

UNIT–II CMS PLANNING AND DESIGN

UNIT–III IMPLEMENTATION OF GT/CMS
Inter and Intra cell layout, cost and non-cost based models, establishing a team approach, Managerial structure and groups, batch sequencing and sizing, life cycle issues in GT/CMS.
UNIT – IV PERFORMANCE MEASUREMENT AND CONTROL


UNIT – V ECONOMICS OF GT/CMS:

Conventional Vs group use of computer models in GT/CMS, Human aspects of GT/CMS - cases.

COURSE OUTCOMES:

- To impart knowledge on group technology, optimization algorithms
- To learn the aspects of cellular manufacturing and its design
- To know the implementation of GT/CMS
- To understand Performance measurements of CMS.
- To understand the economics of GT/CMS

TOTAL: 45 PERIODS

REFERENCES:

1. Askin, R.G. and Vakharia, A.J., G.T " Planning and Operation, in The automated factory-Hand

Mapping of CO with PO

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>AVg.</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

1-low, 2-medium, 3-high, ‘-‘- no correlation
OBJECTIVES:
- To impart knowledge on wafer preparation and PCB fabrication
- To introduce Through Hole Technology (THT) and Surface Mount Technology (SMT) with various types of electronic components
- To elaborate various steps in Surface Mount Technology (SMT)
- To be acquainted with various testing and inspection methods of populated PCBs
- To outline repair, rework and quality aspects of Electronic assemblies.

UNIT I  INTRODUCTION TO ELECTRONICS MANUFACTURING  9
History, definition, wafer preparation by growing, machining, and polishing, diffusion, microlithography, etching and cleaning, Printed Circuit Boards, types- single sided, double sided, multi layer and flexible printed circuit board, design, materials, manufacturing, inspection. Electronic packaging – Through Hole Technology (THT) and Surface Mount Technology (SMT)

UNIT II  COMPONENTS AND PACKAGING  8
Through-hole components – axial, radial, multi leaded, odd form. Surface mount components- active, passive. Interconnections - chip to lead interconnection, die bonding, wire bonding, TAB, Flip chip, chip on board, multi chip module, direct chip array module, leaded, leadless, area array and embedded packaging, miniaturization and trends.

UNIT III  SOLDERING AND CLEANING  9

UNIT IV  SURFACE MOUNT TECHNOLOGY  9
SMT Equipment and Material Handling Systems, Handling of Components and Assemblies - Moisture Sensitivity and ESD, Safety and Precautions Needed, IPC and Other Standards, Stencil Printing Process, solder paste storage and handling, stencils and squeegees, process parameters, quality control - Component Placement, Equipment Type, Chip shooter, IC placer, Flexibility, Accuracy of Placement, Throughput, reflow soldering, adhesive, underfill and encapsulation process, applications, storage and handling, process & parameters.

UNIT V  INSPECTION, TEST AND REWORK FOR PCB:  9

OUTCOMES:
At the end of this course, the students shall be able to:
CO1: Realize wafer preparation and PCB fabrication.
CO2: Elaborate on through hole and surface mount technology components.
CO3: Discuss the steps involved in soldering post solder cleaning and its importance in PCB
manufacturing.
CO4: Improve knowledge on surface mount technology.
CO5: Locate the required inspections, testing and repair methods used in PCB.

REFERENCES

<table>
<thead>
<tr>
<th>PO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</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>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg</td>
<td>(15/5)=3</td>
<td>(6/3)=2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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

UNIT – III FAILURE MODE EFFECTS ANALYSIS AND DESIGN FOR SIX SIGMA

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

UNIT – V STATISTICAL CONSIDERATION AND RELIABILITY

TOTAL:45 PERIODS

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

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>AVg.</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

MF4092 NON-DESTRUCTIVE TESTING

OBJECTIVES:
(1) To stress the importance of NDT in Engineering.
(2) To select the appropriate NDT Technique
(3) To familiarize with different NDT Technique
(4) To impart various knowledge to check the weld quality of various structures, pressure vessels
(5) Compare the merits of various NDT Techniques

UNIT I NON-DESTRUCTIVE TESTING: AN INTRODUCTION, VISUAL INSPECTION & LIQUID PENETRANT TESTING
Introduction to various non-destructive methods, Comparison of Destructive and Non-destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications. Physical principles, procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods-water washable, Post – Emulsification methods, Applications

UNIT II EDDY CURRENT TESTING & ACOUSTIC EMISSION

UNIT III MAGNETIC PARTICLE TESTING & THERMOGRAPHY
Principle of MPT, procedure used for testing a component, Equipment used for MPT, Magnetizing techniques, Applications. Principle of Thermography, Infrared Radiometry, Active thermography measurements, Applications – Imaging entrapped water under an epoxy coating, Detection of carbon fiber contaminants.
UNIT IV  ULTRASONIC TESTING
Principle, Ultrasonic transducers, Ultrasonic Flaw detection Equipment, Modes of display A- scan, B-Scan, C- Scan, Applications, Inspection Methods - Normal Incident Pulse-Echo Inspection, Normal Incident Through-transmission Testing, Angle Beam Pulse-Echo testing, TOFD Technique, Applications of Normal Beam Inspection in detecting fatigue cracks, Inclusions, Slag, Porosity and Intergranular cracks - Codes, standards, specification and procedures and case studies in ultrasonics test.

UNIT V  RADIOGRAPHY
Principle of Radiography, x-ray and gamma ray sources- safety procedures and standards, Effect of radiation on Film, Radiographic imaging, Inspection Techniques – Single wall single image, Double wall Penetration, Multiwall Penetration technique, Real Time Radiography - Codes, standards, specification and procedures and case studies in Radiography test. Case studies on defects in cast, rolled, extruded, welded and heat-treated components - Comparison and selection of various NDT techniques

OUTCOMES:
At the end of this course the students
(1) Realize the importance of various NDT Techniques
(2) Are expected to have hands on experience on all types of NDT techniques
(3) Will choose appropriate technique for testing
(4) Will Compare the merits of various NDT Techniques
(5) Characterize the flaws and defects and provide solutions

TOTAL: 45 PERIODS

REFERENCES:
4. www.ndt.net

CO-PO 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>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Avg.</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:
1. Fundamental concepts of electric and hybrid vehicle operation and architectures.
2. Understand the properties of batteries and its types.
3. Provide knowledge about design of series hybrid electric vehicles.
4. Provide knowledge about design of parallel hybrid electric vehicles.
5. Understand of electric vehicle drive train.

UNIT– I INTRODUCTION TO ELECTRIC VEHICLES 9

UNIT– II ENERGY SOURCE 9

UNIT–III SERIES HYBRID ELECTRIC DRIVE TRAIN DESIGN 9

UNIT– IV PARALLEL HYBRID ELECTRIC DRIVE TRAIN DESIGN 9
Control Strategies of Parallel-Hybrid Drive Train-Drive Train Parameters- Engine Power Capacity - Electric Motor Drive Power Capacity- Transmission Design- Energy Storage Design

UNIT– V ELECTRIC VEHICLE DRIVE TRAIN 9

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1 Explain how a hybrid vehicle works and describe its main components and their function.
CO2 Choose proper energy storage systems for vehicle applications
CO3 Design series hybrid electric vehicles.
CO4 Design parallel hybrid electric vehicles.
CO5 Describe the transmission components and their configurations for electric vehicles.

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

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>AVg.</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

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

ED4073 MATERIAL HANDLING SYSTEMS AND DESIGN L T P C
(Use of Approved Data Book is Permitted) 3 0 0 3

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

UNIT– I INTRODUCTIONS AND DESIGN OF HOISTS 9

UNIT– II DRIVES OF HOISTING GEAR 9
Hand and power drives - Traveling gear - Rail traveling mechanism - cantilever and monorail cranes-slewing, jibandluffinggear-cogwheeldrive-selecting the motor ratings.

UNIT– III CONVEYORS 9
Types-description-design and applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors.

UNIT– IV ELEVATORS 9
Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices-Design of fork lift trucks.

UNIT– V INTEGRATED DESIGN 9
Integrated Design of systems - Valve Gear Mechanisms, Portable Air Compressor, Hay-Balelifter, Cam Testing Machine, Power Screws, Gear Box Design more than six speed.

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

CO1 Design hoists and brakes used in any handling applications.
CO2 Design drive mechanisms and hoisting gear for different handling applications.
CO3 Design different conveyor systems for material handling applications.
CO4 Design bucket, cage and fork lift elevators for to and fro transportation of materials in vertical direction.
CO5 Design of integrated mechanical system for machine tools, power transmission and engine parts

REFERENCES:

APPROVED DATA BOOKS:

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Avg.</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

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

PD4291 DESIGNING WITH ADVANCED MATERIALS

OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Analyzing the different strengthening and failure mechanism of the metals
2. Applying the effects of metallurgical parameters in the materials design
3. Analyzing the relationship between the selection of materials and processing
4. Developing the novel material through understanding the properties of the existing metallic materials
5. Analyzing the different materials used in the engineering applications.
UNIT I INTRODUCTION TO REVERSE ENGINEERING & GEOMETRIC FORM

UNIT II MATERIAL CHARACTERISTICS, PART DURABILITY AND LIFE LIMITATION
Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness – Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure

UNIT III MATERIAL IDENTIFICATION AND PROCESS VERIFICATION

UNIT IV DATA PROCESSING, PART PERFORMANCE AND SYSTEM COMPATIBILITY

UNIT V ACCEPTANCE, LEGALITY AND INDUSTRIAL APPLICATIONS OF RE

TOTAL : 45 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
- Analyze the different strengthening and failure mechanism of the metals
- Apply the effects of metallurgical parameters in the materials design
- Analyze the relationship between the selection of materials and processing
- Develop the novel material through understanding the properties of the existing metallic materials
- Analyze the different materials used in the engineering applications

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Avg.</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

REFERENCES:
8. www.astm.org/labs/pages/131350.htm
AUDIT COURSES

AX4091 ENGLISH FOR RESEARCH PAPER WRITING

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

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

UNIT II PRESENTATION SKILLS

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

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

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

TOTAL: 30 PERIODS

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

REFERENCES
COURSE OBJECTIVES

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

UNIT I  INTRODUCTION  6
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT II  REPERCUSSIONS OF DISASTERS AND HAZARDS  6

UNIT III  DISASTER PRONE AREAS IN INDIA  6
Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics

UNIT IV  DISASTER PREPAREDNESS AND MANAGEMENT  6
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V  RISK ASSESSMENT  6
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

COURSE OUTCOMES

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

REFERENCES

OBJECTIVES
Students will be able to:

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

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

UNIT II  PHILOSOPHY OF THE INDIAN CONSTITUTION
Preamble, Salient Features

UNIT III  CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

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

UNIT V  LOCAL ADMINISTRATION

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

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.
SUGGESTED READING
- The Constitution of India, 1950 (Bare Act), Government Publication.

AX4094 தமிழ் தலைப்பிட்டம்

UNIT I
1. குறிப்பிட்டு வருவாகும் பதிவுகள்
   - குழுநிலை, நி஦ிர்சன, வம்ச வருவாகும்
2. குறிப்பிட்டு வருவாகும் (82)
   - பட்டியல்கள் விலக்கினை அல்லது
3. குறிப்பிட்டு வருவாகும் (83)
4. பட்டியல்கள் (95, 195)
   - பட்டியல்கள் நிதிக்கீட் எள்ளமைப்பு

UNIT II
1. அறநூற்றூற்று நிகழ்வுச் சுருக்கம்
   - அறநூற்றூற்று, அன்புகடகம், ஒப்புரவறிதல், ஈகக, புகழ்
2. பிற அறநூற்றூற்றுகள்
   - நூற்றூற்று, சிறுபஞ்சமல், சிறுவரிசம், அரங்கோயில்

UNIT III
1. குறிப்பிட்டு வருவாகும் பதிவு
   - குறிப்பிட்டு வருவாகும் பதிவு
2. குறிப்பிட்டு வருவாகும் பதிவு
   - குறிப்பிட்டு வருவாகும் பதிவு

UNIT IV
1. குறிப்பிட்டு வருவாகும் பதிவு
   - பதிவு வருவாகும் பதிவு, பதிவு வருவாகும் பதிவு
2. குறிப்பிட்டு வருவாகும் பதிவு
   - குறிப்பிட்டு வருவாகும் பதிவு
3. குறிப்பிட்டு (617, 618)
   - மூலம் மூலம் விளிம்பு
4. குறிப்பிட்டு (617, 618)
   - மூலம் மூலம் விளிம்பு
5. குறிப்பிட்டு (617, 618)
   - மூலம் மூலம் விளிம்பு
UNIT V

தொண்டு தமிழ் தொகுதியாக

1. செயல்பட்டத் தமிழ்,
- குறிப்பிட்டு புதுக்கம்,
- வீரியம் புதுக்கம்
- குழுக்கார் தொகுதியாக,
- முழுக்க தொகுதியாக,
- தமிழ்

2. மனந் கிளாசு இழக்கொள்ள தமிழ் தொகுதியாக,
3. தமிழ் கிளாசு இழக்கொள்ள தமிழ் தொகுதியாக,
4. தமிழ் கிளாசு இழக்கொள்ள விளம்பு மீண்டுசெய்யப்பட்டு தமிழ் தொகுதியாக,
5. வளிமது தமிழ்,
6. வளுமது தமிழ்,
7. தமிழ் கிளாசு இழக்கொள்ள தமிழ் தொகுதியாக,

TOTAL: 30 PERIODS

தமிழ் தொகுதியாக வழிப்பட்டு / பகுதிகள்

1. தமிழ் தொகுதியாக வழிப்பட்டு (Tamil Virtual University) - www.tamilvu.org
2. தமிழ் விக்கிப்பீட்டு (Tamil Wikipedia) - https://ta.wikipedia.org
3. தமிழ் விளம்பு பல்கலைக்கழகம்
4. தமிழ் விளம்பு கல்வி பல்கலைக்கழகம் - சென்னை, தமிழ்நாடு
5. தமிழ் விளம்பு கல்வி பல்கலைக்கழகம் - தமிழ் வளர்சித் தொகுதி (thamilvalarchithurai.com)
6. தமிழ் விளம்பு கல்வி பல்கலைக்கழகம் - சென்னை, தமிழ்நாடு
OBJECTIVE

- Students will be introduced to the concepts and principles of IWRM, which is inclusive of the economics, public-private partnership, water & health, water & food security and legal & regulatory settings.

UNIT I CONTEXT FOR IWRM

Water as a global issue: key challenges – Definition of IWRM within the broader context of development – Key elements of IWRM - Principles – Paradigm shift in water management - Complexity of the IWRM process – UN World Water Assessment - SDGs.

UNIT II WATER ECONOMICS

Economic view of water issues: economic characteristics of water good and services – Non-market monetary valuation methods – Water economic instruments – Private sector involvement in water resources management: PPP objectives, PPP models, PPP processes, PPP experiences through case studies.

UNIT III LEGAL AND REGULATORY SETTINGS

Basic notion of law and governance: principles of international and national law in the area of water management - Understanding UN law on non-navigable uses of international water courses – International law for groundwater management – World Water Forums – Global Water Partnerships - Development of IWRM in line with legal and regulatory framework.

UNIT IV WATER AND HEALTH WITHIN THE IWRM CONTEXT

Links between water and health: options to include water management interventions for health – Health protection and promotion in the context of IWRM – Global burden of Diseases - Health impact assessment of water resources development projects – Case studies.

UNIT V AGRICULTURE IN THE CONCEPT OF IWRM


TOTAL: 45 PERIODS

OUTCOMES

- On completion of the course, the student is expected to be able to

| CO1 | Describe the context and principles of IWRM; Compare the conventional and integrated ways of water management. |
| CO2 | Select the best economic option among the alternatives; illustrate the pros and cons of PPP through case studies. |
| CO3 | Apply law and governance in the context of IWRM. |
| CO4 | Discuss the linkages between water-health; develop a HIA framework. |
| CO5 | Analyse how the virtual water concept pave way to alternate policy options. |
REFERENCES:

OCE432 WATER, SANITATION AND HEALTH L T P C 3 0 0 3

OBJECTIVES:
• Understand the accelerating health impacts due to the present managerial aspects and initiatives in water and sanitation and health sectors in the developing scenario

UNIT I FUNDAMENTALS WASH 9
Meanings and Definition: Safe Water- Health, Nexus: Water- Sanitation - Health and Hygiene – Equity issues-Water security - Food Security. Sanitation And Hygiene (WASH) and Integrated Water Resources Management (IWRM) - Need and Importance of WASH

UNIT II MANAGERIAL IMPLICATIONS AND IMPACT 9

UNIT III CHALLENGES IN MANAGEMENT AND DEVELOPMENT 9

UNIT IV GOVERNANCE 9
Public health -Community Health Assessment and Improvement Planning (CHA/CHIP)-Infrastructure and Investments on Water, (WASH) - Cost Benefit Analysis -- Institutional Intervention-Public Private Partnership - Policy Directives - Social Insurance -Political Will vs Participatory Governance -
UNIT V INITIATIVES

Management vs Development - Accelerating Development - Development Indicators - Inclusive Development - Global and Local - Millennium Development Goal (MDG) and Targets - Five Year Plans - Implementation - Capacity Building - Case studies on WASH.

TOTAL: 45 PERIODS

OUTCOMES:

| CO1 | Capture to fundamental concepts and terms which are to be applied and understood all through the study. |
| CO2 | Comprehend the various factors affecting water sanitation and health through the lens of third world scenario. |
| CO3 | Critically analyse and articulate the underlying common challenges in water, sanitation and health. |
| CO4 | Acquire knowledge on the attributes of governance and its say on water sanitation and health. |
| CO5 | Gain an overarching insight into the aspects of sustainable resource management in the absence of a clear level playing field in the developmental aspects. |

REFERENCES


OCE433 PRINCIPLES OF SUSTAINABLE DEVELOPMENT L T P C

3 0 0 3

OBJECTIVES:

- To impart knowledge on environmental, social and economic dimensions of sustainability and the principles evolved through landmark events so as to develop an action mindset for sustainable development.

UNIT I SUSTAINABILITY AND DEVELOPMENT CHALLENGES

UNIT II PRINCIPLES AND FRAME WORK

UNIT III SUSTAINABLE DEVELOPMENT AND WELLBEING

UNIT IV SUSTAINABLE SOCIO-ECONOMIC SYSTEMS

UNIT V ASSESSING PROGRESS AND WAY FORWARD

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to

| CO1 | Explain and evaluate current challenges to sustainability, including modern world social, environmental, and economic structures and crises. |
| CO2 | Identify and critically analyze the social environmental, and economic dimensions of sustainability in terms of UN Sustainable development goals |
| CO3 | Develop a fair understanding of the social, economic and ecological linkage of Human well being, production and consumption |
| CO4 | Evaluate sustainability issues and solutions using a holistic approach that focuses on connections between complex human and natural systems. |
| CO5 | Integrate knowledge from multiple sources and perspectives to understand environmental limits governing human societies and economies and social justice dimensions of sustainability. |

REFERENCES:

OCE434 ENVIRONMENTAL IMPACT ASSESSMENT

L T P C 3 0 0 3

OBJECTIVES:
- To make the students to understand environmental clearance, its legal requirements and to provide knowledge on overall methodology of EIA, prediction tools and models, environmental management plan and case studies.

UNIT I INTRODUCTION

UNIT II IMPACT IDENTIFICATION AND PREDICTION

UNIT III SOCIO-ECONOMIC IMPACT ASSESSMENT
Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts. communities in transition-rehabilitation

UNIT IV EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN
Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact assessment

UNIT V CASE STUDIES
Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects

TOTAL: 45 PERIODS

OUTCOMES:
- On completion of the course, the student is expected to be able to

<table>
<thead>
<tr>
<th>CO1</th>
<th>Understand need for environmental clearance, its legal procedure, need of EIA, its types, stakeholders and their roles</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Understand various impact identification methodologies, prediction techniques and model of impacts on various environments</td>
</tr>
</tbody>
</table>
**REFERENCES:**

1. EIA Notification 2006 including recent amendments, by Ministry of Environment, Forest and Climate Change, Government of India
2. Sectoral Guidelines under EIA Notification by Ministry of Environment, Forest and Climate Change, Government of India

### CO – PO Mapping- ENVIRONMENTAL IMPACT ASSESSMENT

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>Course Outcome</th>
<th>Overall Correlation of COs to Pos</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CO1</td>
<td>CO2</td>
</tr>
<tr>
<td>PO1 Knowledge of Engineering Sciences</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO2 Problem analysis</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO3 Design / development of solutions</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO4 Investigation</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO5 Modern Tool Usage</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO6 Individual and Team work</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO7 Communication</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>PO8 Engineer and Society</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>PO9 Ethics</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO10 Environment and Sustainability</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PO11 Project Management and Finance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO12 Life Long Learning</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PSO1 Knowledge of Environmental Engineering discipline</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>PSO2 Environmental Performance Evaluation and coordination</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PSO3 Conceptualization of Environmental Engineering Systems</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:
- This course is intended to study the basics of Blockchain technology.
- During this course the learner will explore various aspects of Blockchain technology like application in various domains.
- By implementing, learners will have idea about private and public Blockchain, and smart contract.

UNIT I  INTRODUCTION OF CRYPTOGRAPHY AND BLOCKCHAIN  9
Introduction to Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions and Blocks, P2P Systems, Keys as Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.

UNIT II  BITCOIN AND CRYPTOCURRENCY  9

UNIT III INTRODUCTION TO ETHEREUM  9
Introduction to Ethereum, Consensus Mechanisms, Metamask Setup, Ethereum Accounts, Transactions, Receiving Ethers, Smart Contracts.

UNIT IV  INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING  10

UNIT V  BLOCKCHAIN APPLICATIONS  8
Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
After the completion of this course, student will be able to
CO1: Understand and explore the working of Blockchain technology
CO2: Analyze the working of Smart Contracts
CO3: Understand and analyze the working of Hyperledger
CO4: Apply the learning of solidity to build de-centralized apps on Ethereum
CO5: Develop applications on Blockchain

REFERENCES:
OIC432 DEEP LEARNING

COURSE OBJECTIVES:

- Develop and Train Deep Neural Networks.
- Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
- Build and train RNNs, work with NLP and Word Embeddings
- The internal structure of LSTM and GRU and the differences between them
- The Auto Encoders for Image Processing

UNIT I DEEP LEARNING CONCEPTS


UNIT II NEURAL NETWORKS


UNIT III CONVOLUTIONAL NEURAL NETWORK


UNIT VI NATURAL LANGUAGE PROCESSING USING RNN

UNIT V DEEP REINFORCEMENT & UNSUPERVISED LEARNING


COURSE OUTCOMES:
CO1: Feature Extraction from Image and Video Data
CO2: Implement Image Segmentation and Instance Segmentation in Images
CO3: Implement image recognition and image classification using a pretrained network (Transfer Learning)
CO4: Traffic Information analysis using Twitter Data
CO5: Autoencoder for Classification & Feature Extraction

TOTAL : 45 PERIODS

REFERENCES
1. Deep Learning A Practitioner’s Approach Josh Patterson and Adam Gibson O’Reilly Media, Inc.2017
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017

OBA431 SUSTAINABLE MANAGEMENT

COURSE OBJECTIVES:
- To provide students with fundamental knowledge of the notion of corporate sustainability.
- To determine how organizations impacts on the environment and socio-technical systems, the relationship between social and environmental performance and competitiveness, the approaches and methods.

UNIT I MANAGEMENT OF SUSTAINABILITY
Management of sustainability - rationale and political trends: An introduction to sustainability management, International and European policies on sustainable development, theoretical pillars in sustainability management studies.

UNIT II CORPORATE SUSTAINABILITY AND RESPONSIBILITY
Corporate sustainability parameter, corporate sustainability institutional framework, integration of sustainability into strategic planning and regular business practices, fundamentals of stakeholder engagement.

UNIT III SUSTAINABILITY MANAGEMENT: STRATEGIES AND APPROACHES
Corporate sustainability management and competitiveness: Sustainability-oriented corporate strategies, markets and competitiveness, Green Management between theory and practice, Sustainable Consumption and Green Marketing strategies, Environmental regulation and strategic postures; Green Management approaches and tools; Green engineering: clean technologies and innovation processes; Sustainable Supply Chain Management and Procurement.
UNIT IV  SUSTAINABILITY AND INNOVATION 9
Socio-technical transitions and sustainability, Sustainable entrepreneurship, Sustainable pioneers in green market niches, Smart communities and smart specializations.

UNIT V  SUSTAINABLE MANAGEMENT OF RESOURCES, COMMODITIES AND COMMONS 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: An understanding of sustainability management as an approach to aid in evaluating and minimizing environmental impacts while achieving the expected social impact.
CO2: An understanding of corporate sustainability and responsible Business Practices
CO3: Knowledge and skills to understand, to measure and interpret sustainability performances.
CO4: Knowledge of innovative practices in sustainable business and community management
CO5: Deep understanding of sustainable management of resources and commodities

REFERENCES:
4. Margaret Robertson, Sustainability Principles and Practice, 2014
5. Peter Rogers, An Introduction to Sustainable Development, 2006

MAPPING OF POs AND COs:

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

OBA432  MICRO AND SMALL BUSINESS MANAGEMENT  L T P C
3 0 0 3

COURSE OBJECTIVES
- To familiarize students with the theory and practice of small business management.
- To learn the legal issues faced by small business and how they impact operations.

UNIT I  INTRODUCTION TO SMALL BUSINESS 9
cycle - barriers and triggers to new venture creation – process to assist start ups – small business and family business.

UNIT II  SCREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN 9
Concepts of opportunity recognition; Key factors leading to new venture failure; New venture screening process; Applying new venture screening process to the early stage small firm Role planning in small business – importance of strategy formulation – management skills for small business creation and development.

UNIT III  BUILDING THE RIGHT TEAM AND MARKETING STRATEGY 9
Management and Leadership – employee assessments – Tuckman’s stages of group development - The entrepreneurial process model - Delegation and team building - Comparison of HR management in small and large firms - Importance of coaching and how to apply a coaching model. Marketing within the small business - success strategies for small business marketing - customer delight and business generating systems - market research, - assessing market performance- sales management and strategy - the marketing mix and marketing strategy.

UNIT IV  FINANCING SMALL BUSINESS 9
Main sources of entrepreneurial capital; Nature of ‘bootstrap’ financing - Difference between cash and profit - Nature of bank financing and equity financing - Funding-equity gap for small firms. Importance of working capital cycle - Calculation of break-even point - Power of gross profit margin-Pricing for profit - Credit policy issues and relating these to cash flow management and profitability.

UNIT V  VALUING SMALL BUSINESS AND CRISIS MANAGEMENT 9
Causes of small business failure - Danger signals of impending trouble - Characteristics of poorly performing firms - Turnaround strategies - Concept of business valuation - Different valuation measurements - Nature of goodwill and how to measure it - Advantages and disadvantages of buying an established small firm - Process of preparing a business for sale.

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1. Familiarise the students with the concept of small business
CO2. In depth knowledge on small business opportunities and challenges
CO3. Ability to devise plans for small business by building the right skills and marketing strategies
CO4. Identify the funding source for small start ups
CO5. Business evaluation for buying and selling of small firms

REFERENCES
3. Journal articles on SME’s.

MAPPING OF POs AND COs

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVE

➢ To understand intellectual property rights and its valuation.

UNIT I INTRODUCTION
Intellectual property rights - Introduction, Basic concepts, Patents, Copyrights, Trademarks, Trade Secrets, Geographic Indicators; Nature of Intellectual Property, Technological Research, Inventions and Innovations, History - the way from WTO to WIPO, TRIPS.

UNIT II PROCESS
New Developments in IPR, Procedure for grant of Patents, TM, GIs, Patenting under Patent Cooperation Treaty, Administration of Patent system in India, Patenting in foreign countries.

UNIT III STATUTES

UNIT IV STRATEGIES IN INTELLECTUAL PROPERTY
Strategies for investing in R&D, Patent Information and databases, IPR strength in India, Traditional Knowledge, Case studies.

UNIT V MODELS
The technologies Know-how, concept of ownership, Significance of IP in Value Creation, IP Valuation and IP Valuation Models, Application of Real Option Model in Strategic Decision Making, Transfer and Licensing.

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: Understanding of intellectual property and appreciation of the need to protect it
CO2: Awareness about the process of patenting
CO3: Understanding of the statutes related to IPR
CO4: Ability to apply strategies to protect intellectual property
CO5: Ability to apply models for making strategic decisions related to IPR

REFERENCES
2. Intellectual Property rights and copyrights, EssEss Publications.

MAPPING OF POs AND COs

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>
OBA434 ETHICAL MANAGEMENT 3 0 0 3

COURSE OBJECTIVE
➢ To help students develop knowledge and competence in ethical management and decision making in organizational contexts.

UNIT I ETHICS AND SOCIETY
Ethical Management- Definition, Motivation, Advantages-Practical implications of ethical management. Managerial ethics, professional ethics, and social Responsibility-Role of culture and society’s expectations- Individual and organizational responsibility to society and the community.

UNIT II ETHICAL DECISION MAKING AND MANAGEMENT IN A CRISIS
Managing in an ethical crisis, the nature of a crisis, ethics in crisis management, discuss case studies, analyze real-world scenarios, develop ethical management skills, knowledge, and competencies. Proactive crisis management.

UNIT III STAKEHOLDERS IN ETHICAL MANAGEMENT
Stakeholders in ethical management, identifying internal and external stakeholders, nature of stakeholders, ethical management of various kinds of stakeholders: customers (product and service issues), employees (leadership, fairness, justice, diversity) suppliers, collaborators, business, community, the natural environment (the sustainability imperative, green management, Contemporary issues).

UNIT IV INDIVIDUAL VARIABLES IN ETHICAL MANAGEMENT
Understanding individual variables in ethics, managerial ethics, concepts in ethical psychology- ethical awareness, ethical courage, ethical judgment, ethical foundations, ethical emotions/intuitions/intensity. Utilization of these concepts and competencies for ethical decision-making and management.

UNIT V PRACTICAL FIELD-GUIDE, TECHNIQUES AND SKILLS
Ethical management in practice, development of techniques and skills, navigating challenges and dilemmas, resolving issues and preventing unethical management proactively. Role modelling and creating a culture of ethical management and human flourishing.

TOTAL: 45 PERIODS

COURSE OUTCOMES
CO1: Role modelling and influencing the ethical and cultural context.
CO2: Respond to ethical crises and proactively address potential crises situations.
CO3: Understand and implement stakeholder management decisions.
CO4: Develop the ability, knowledge, and skills for ethical management.
CO5: Develop practical skills to navigate, resolve and thrive in management situations

REFERENCES
MAPPING OF POs AND COs

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

ET4251 IoT FOR SMART SYSTEMS LT P C 3 0 0 3

COURSE OBJECTIVES:
1. To study about Internet of Things technologies and its role in real time applications.
2. To introduce the infrastructure required for IoT.
3. To familiarize the accessories and communication techniques for IoT.
4. To provide insight about the embedded processor and sensors required for IoT.
5. To familiarize the different platforms and Attributes for IoT.

UNIT I INTRODUCTION TO INTERNET OF THINGS
Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.

UNIT II IOT ARCHITECTURE

UNIT III PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT
PROTOCOLS:
NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe GSM, CDMA, LTE, GPRS, small cell.

Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems-Recent trends.

UNIT IV IOT PROCESSORS
Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability.
Embedded processors for IOT : Introduction to Python programming - Building IOT with RASPERY PI and Arduino.

UNIT V CASE STUDIES
Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students will have the ability to
CO1: Analyze the concepts of IoT and its present developments.
CO2: Compare and contrast different platforms and infrastructures available for IoT
CO3: Explain different protocols and communication technologies used in IoT
CO4: Analyze the big data analytic and programming of IoT
CO5: Implement IoT solutions for smart applications

<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>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<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>
<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>
</tr>
<tr>
<td>Avg.</td>
<td></td>
<td>1.75</td>
<td>2.33</td>
<td>2.33</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

REFERENCES:
COURSE OBJECTIVES:
The course is aimed at
1. Understanding about the learning problem and algorithms
2. Providing insight about neural networks
3. Introducing the machine learning fundamentals and significance
4. Enabling the students to acquire knowledge about pattern recognition.
5. Motivating the students to apply deep learning algorithms for solving real life problems.

UNIT I       LEARNING PROBLEMS AND ALGORITHMS
Various paradigms of learning problems, Supervised, Semi-supervised and Unsupervised algorithms

UNIT II      NEURAL NETWORKS

UNIT III     MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS
Classifying Samples: The confusion matrix, Accuracy, Precision, Recall, F1- Score, the curse of dimensionality, training, testing, validation, cross validation, overfitting, under-fitting the data, early stopping, regularization, bias and variance. Feature Selection, normalization, dimensionality reduction, Classifiers: KNN, SVM, Decision trees, Naïve Bayes, Binary classification, multi class classification, clustering.

UNIT IV      DEEP LEARNING: CONVOLUTIONAL NEURAL NETWORKS
Feed forward networks, Activation functions, back propagation in CNN, optimizers, batch normalization, convolution layers, pooling layers, fully connected layers, dropout, Examples of CNNs.

UNIT V       DEEP LEARNING: RNNS, AUTOENCODERS AND GANS
State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text, Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs

TOTAL : 45 PERIODS

COURSE OUTCOMES (CO):
At the end of the course the student will be able to
CO1 : Illustrate the categorization of machine learning algorithms.
CO2: Compare and contrast the types of neural network architectures, activation functions
CO3: Acquaint with the pattern association using neural networks
CO4: Elaborate various terminologies related with pattern recognition and architectures of convolutional neural networks
CO5: Construct different feature selection and classification techniques and advanced neural network architectures such as RNN, Autoencoders, and GANs.
REFERENCES:

PX4012 RENEWABLE ENERGY TECHNOLOGY

OBJECTIVES:
To impart knowledge on
• Different types of renewable energy technologies
• Standalone operation, grid connected operation of renewable energy systems

UNIT I INTRODUCTION
Classification of energy sources – Co2 Emission - Features of Renewable energy - Renewable energy scenario in India - Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment Per Capital Consumption - CO2 Emission - importance of renewable energy sources, Potentials – Achievements – Applications.

UNIT II SOLAR PHOTOVOLTAICS

UNIT III PHOTOVOLTAIC SYSTEM DESIGN
Block diagram of solar photo voltaic system: Line commutated converters (inversion mode) - Boost and buck-boost converters - selection of inverter, battery sizing, array sizing - PV systems classification- standalone PV systems - Grid tied and grid interactive inverters- grid connection issues.

UNIT IV WIND ENERGY CONVERSION SYSTEMS

UNIT V OTHER RENEWABLE ENERGY SOURCES
Qualitative study of different renewable energy resources: ocean, Biomass, Hydrogen energy systems, Fuel cells, Ocean Thermal Energy Conversion (OTEC), Tidal and wave energy, Geothermal Energy Resources.

TOTAL : 45 PERIODS

OUTCOMES:
After completion of this course, the student will be able to:
CO1: Demonstrate the need for renewable energy sources.
CO2: Develop a stand-alone photo voltaic system and implement a maximum power point tracking in the PV system.
CO3: Design a stand-alone and Grid connected PV system.
CO4: Analyze the different configurations of the wind energy conversion systems.
CO5: Realize the basic of various available renewable energy sources.

REFERENCES:

CO-PO MAPPING:

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES
- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To know about the function of smart grid.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high performance computing for Smart Grid applications.
- To get familiarized with the communication networks for Smart Grid applications.

UNIT I INTRODUCTION TO SMART GRID
Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Comparison of Micro grid and Smart grid, Present development & International policies in Smart Grid, Smart Grid Initiative for Power Distribution Utility in India – Case Study.

UNIT II SMART GRID TECHNOLOGIES
Technology Drivers, Smart Integration of energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/Var control, Fault Detection, Isolation and service restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV) – Grid to Vehicle and Vehicle to Grid charging concepts.

UNIT III SMART METERS AND ADVANCED METERING INFRASTRUCTURE
Introduction to Smart Meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, standards and initiatives, AMI needs in the smart grid, Phasor Measurement Unit (PMU) & their application for monitoring & protection. Demand side management and demand response programs, Demand pricing and Time of Use, Real Time Pricing, Peak Time Pricing.

UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID

Unit V HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS
Architecture and Standards - Local Area Network (LAN), House Area Network (HAN), Wide Area Network (WAN), Broadband over Power line (BPL), PLC, Zigbee, GSM, IP based Protocols, Basics of Web Service and CLOUD Computing, Cyber Security for Smart Grid.

COURSE OUTCOME:
Students able to:
CO1: Relate with the smart resources, smart meters and other smart devices.
CO2: Explain the function of Smart Grid.
CO3: Experiment the issues of Power Quality in Smart Grid.
CO4: Analyze the performance of Smart Grid.
CO5: Recommend suitable communication networks for smart grid applications.
REFERENCES

MAPPING OF CO’S WITH PO’S

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>AVG</td>
<td>2.25</td>
<td>2</td>
<td>1.66</td>
<td>2.25</td>
<td>2.3</td>
<td>2</td>
</tr>
</tbody>
</table>

CP4391 SECURITY PRACTICES

COURSE OBJECTIVES:
- To learn the core fundamentals of system and web security concepts
- To have through understanding in the security concepts related to networks
- To deploy the security essentials in IT Sector
- To be exposed to the concepts of Cyber Security and cloud security
- To perform a detailed study of Privacy and Storage security and related Issues

UNIT I SYSTEM SECURITY

UNIT II NETWORK SECURITY

UNIT III SECURITY MANAGEMENT

UNIT IV CYBER SECURITY AND CLOUD SECURITY
infrastructure management – Establishing trust in IaaS, PaaS, and SaaS Cloud types. Case study: DVWA

UNIT V PRIVACY AND STORAGE SECURITY

COURSE OUTCOMES:
CO1: Understand the core fundamentals of system security
CO2: Apply the security concepts to wired and wireless networks
CO3: Implement and Manage the security essentials in IT Sector
CO4: Explain the concepts of Cyber Security and Cyber forensics
CO5: Be aware of Privacy and Storage security Issues.

REFERENCES

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Avg</td>
<td>1.50</td>
<td>1.67</td>
<td>1.60</td>
<td>1.60</td>
<td>1.80</td>
<td>2.40</td>
</tr>
</tbody>
</table>

TOTAL: 45 PERIODS
COURSE OBJECTIVES:
- To gain expertise in Virtualization, Virtual Machines and deploy practical virtualization solution
- To understand the architecture, infrastructure and delivery models of cloud computing.
- To explore the roster of AWS services and illustrate the way to make applications in AWS
- To gain knowledge in the working of Windows Azure and Storage services offered by Windows Azure
- To develop the cloud application using various programming model of Hadoop and Aneka

UNIT I  VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE  6
Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines – Emulation –
Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization – Management
Virtualization — Hardware Maximization – Architectures – Virtualization Management – Storage
Virtualization – Network Virtualization- Implementation levels of virtualization – virtualization structure
– virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management –
Virtualization for data center automation

UNIT II  CLOUD PLATFORM ARCHITECTURE  12
Cloud Computing: Definition, Characteristics - Cloud deployment models: public, private, hybrid,
community – Categories of cloud computing: Everything as a service: Infrastructure, platform,
software- A Generic Cloud Architecture Design – Layered cloud Architectural Development –
Architectural Design Challenges

UNIT III  AWS CLOUD PLATFORM - IIAAS  9
Amazon Web Services: AWS Infrastructure- AWS API- AWS Management Console - Setting up
AWS Storage - Stretching out with Elastic Compute Cloud - Elastic Container Service for Kubernetes-
Pipeline, AWS code Star - AWS Management Tools: Cloud Watch, AWS Auto Scaling, AWS control
Tower, Cloud Formation, Cloud Trail, AWS License Manager

UNIT IV  PAAS CLOUD PLATFORM  9
Windows Azure- Service Model and Managing Services: Definition and Configuration, Service runtime
API- Windows Azure Developer Portal - Service Management API- Windows Azure Storage
Characteristics-Storage Services- REST API- Blops

UNIT V  PROGRAMMING MODEL  9
Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying
input and output parameters, configuring and running a job –Developing Map Reduce Applications -
Design of Hadoop file system – Setting up Hadoop Cluster- Aneka: Cloud Application Platform, Thread
Programming, Task Programming and Map-Reduce Programming in Aneka

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Employ the concepts of virtualization in the cloud computing
CO2: Identify the architecture, infrastructure and delivery models of cloud computing
CO3: Develop the Cloud Application in AWS platform
CO4: Apply the concepts of Windows Azure to design Cloud Application
CO5: Develop services using various Cloud computing programming models.
REFERENCES

IF4072 DESIGN THINKING L T P C
3 0 0 3

COURSE OBJECTIVES:
- To provide a sound knowledge in UI & UX
- To understand the need for UI and UX
- Research Methods used in Design
- Tools used in UI & UX
- Creating a wireframe and prototype

UNIT I UX LIFECYCLE TEMPLATE

UNIT II CONTEXTUAL INQUIRY

UNIT III DESIGN THINKING, IDEATION, AND SKETCHING
UNIT IV  
UX GOALS, METRICS, AND TARGETS


UNIT V  
ANALYSING USER EXPERIENCE


SUGGESTED ACTIVITIES:
1: Hands on Design Thinking process for a product
2: Defining the Look and Feel of any new Project
3: Create a Sample Pattern Library for that product (Mood board, Fonts, Colors based on UI principles)
4: Identify a customer problem to solve.
5: Conduct end-to-end user research - User research, creating personas, Ideation process (User stories, Scenarios), Flow diagrams, Flow Mapping

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: Build UI for user Applications
CO2: Use the UI Interaction behaviors and principles
CO3: Evaluate UX design of any product or application
CO4: Demonstrate UX Skills in product development
CO5: Implement Sketching principles

REFERENCES
4. Lean UX: Designing Great Products with Agile Teams, Gothelf, Jeff, Seiden, and Josh. O'Reilly Media, 2016
5. Designing UX: Prototyping: Because Modern Design is Never Static, Ben Coleman, and Dan Goodwin. SitePoint, 2017
COURSE OBJECTIVES:
- To get familiarity with gamut of multimedia and its significance
- To acquire knowledge in multimedia components.
- To acquire knowledge about multimedia tools and authoring.
- To acquire knowledge in the development of multimedia applications.
- To explore the latest trends and technologies in multimedia

UNIT I  INTRODUCTION  9

Suggested Activities:
1. Flipped classroom on media Components.
2. External learning – Interactive presentation.

Suggested Evaluation Methods:
1. Tutorial – Handling media components
2. Quizzes on different types of data presentation.

UNIT II  ELEMENTS OF MULTIMEDIA  9
Text-Types, Font, Unicode Standard, File Formats, Graphics and Image data representations – data types, file formats, color models; video – color models in video, analog video, digital video, file formats, video display interfaces, 3D video and TV: Audio – Digitization, SNR, SQNR, quantization, audio quality, file formats, MIDI; Animation- Key Frames and Tweening, other Techniques, 2D and 3D Animation.

Suggested Activities:
1. Flipped classroom on different file formats of various media elements.

Suggested Evaluation Methods:
1. Demonstration on after effects animations.
2. Quizzes on file formats and color models.

UNIT III  MULTIMEDIA TOOLS  9

Suggested Activities:
1. Flipped classroom on multimedia tools.
2. External learning – Comparison of various authoring tools.

Suggested Evaluation Methods:
1. Tutorial – Audio editing tool.
2. Quizzes on animation tools.
UNIT IV  MULTIMEDIA SYSTEMS


Suggested Activities:
1. Flipped classroom on concepts of multimedia hardware architectures.
2. External learning – Digital repositories and hypermedia design.

Suggested Evaluation Methods:
1. Quizzes on multimedia hardware and compression techniques.
2. Tutorial – Hypermedia design.

UNIT V  MULTIMEDIA APPLICATIONS FOR THE WEB AND MOBILE PLATFORMS


Suggested Activities:
1. External learning – Game consoles.
2. External learning – VRML scripting languages.

Suggested Evaluation Methods:
1. Demonstration of simple interactive games.
2. Tutorial – Simple VRML program.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: Handle the multimedia elements effectively.
CO2: Articulate the concepts and techniques used in multimedia applications.
CO3: Develop effective strategies to deliver Quality of Experience in multimedia applications.
CO4: Design and implement algorithms and techniques applied to multimedia objects.
CO5: Design and develop multimedia applications following software engineering models.

REFERENCES:
COURSE OBJECTIVES:
- To understand the basics of big data analytics
- To understand the search methods and visualization
- To learn mining data streams
- To learn frameworks
- To gain knowledge on R language

UNIT I  INTRODUCTION TO BIG DATA  9

UNIT II  SEARCH METHODS AND VISUALIZATION  9

UNIT III  MINING DATA STREAMS  9

UNIT IV  FRAMEWORKS  9
MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Case Study- Preventing Private Information Inference Attacks on Social Networks- Grand Challenge: Applying Regulatory Science and Big Data to Improve Medical Device Innovation

UNIT V  R LANGUAGE  9

COURSE OUTCOMES:
CO1: understand the basics of big data analytics
CO2: Ability to use Hadoop, Map Reduce Framework.
CO3: Ability to identify the areas for applying big data analytics for increasing the business outcome.
CO4: gain knowledge on R language
CO5: Contextually integrate and correlate large amounts of information to gain faster insights.

TOTAL: 45 PERIODS

REFERENCE:
NC4201        INTERNET OF THINGS AND CLOUD \hspace{1cm} L T P C

3 0 0 3

COURSE OBJECTIVES:
- To understand Smart Objects and IoT Architectures
- To learn about various IOT-related protocols
- To build simple IoT Systems using Arduino and Raspberry Pi.
- To understand data analytics and cloud in the context of IoT
- To develop IoT infrastructure for popular applications

UNIT I  FUNDAMENTALS OF IoT

UNIT II PROTOCOLS FOR IoT

UNIT III CASE STUDIES/INDUSTRIAL APPLICATIONS
Case studies with architectural analysis: IoT applications – Smart City – Smart Water – Smart Agriculture – Smart Energy – Smart Healthcare – Smart Transportation – Smart Retail – Smart waste management.

UNIT IV CLOUD COMPUTING INTRODUCTION

UNIT V  IoT AND CLOUD

TOTAL:45 PERIODS
COURSE OUTCOMES:
At the end of the course, the student will be able to:
CO1: Understand the various concept of the IoT and their technologies.
CO2: Develop IoT application using different hardware platforms
CO3: Implement the various IoT Protocols
CO4: Understand the basic principles of cloud computing.
CO5: Develop and deploy the IoT application into cloud environment

REFERENCES

MX4073 MEDICAL ROBOTICS L T P C
3 0 0 3

COURSE OBJECTIVES:
- To explain the basic concepts of robots and types of robots
- To discuss the designing procedure of manipulators, actuators and grippers
- To impart knowledge on various types of sensors and power sources
- To explore various applications of Robots in Medicine
- To impart knowledge on wearable robots

UNIT I INTRODUCTION TO ROBOTICS
Introduction to Robotics, Overview of robot subsystems, Degrees of freedom, configurations and concept of workspace, Dynamic Stabilization

Sensors and Actuators
Sensors and controllers, Internal and external sensors, position, velocity and acceleration sensors, Proximity sensors, force sensors Pneumatic and hydraulic actuators, Stepper motor control circuits, End effectors, Various types of Grippers, PD and PID feedback actuator models

UNIT II MANIPULATORS & BASIC KINEMATICS
Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and pneumatic manipulator, Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inverse Kinematic problems

Navigation and Treatment Planning
Variable speed arrangements, Path determination – Machinery vision, Ranging – Laser – Acoustic, Magnetic, fiber optic and Tactile sensor

UNIT III SURGICAL ROBOTS
Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump, CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric and General Surgery, Gynecologic Surgery, General Surgery and Nanorobotics. Case Study

UNIT IV REHABILITATION AND ASSISTIVE ROBOTS
Pediatric Rehabilitation, Robotic Therapy for the Upper Extremity and Walking, Clinical-Based
Gait Rehabilitation Robots, Motion Correlation and Tracking, Motion Prediction, Motion Replication. Portable Robot for Tele rehabilitation, Robotic Exoskeletons – Design considerations, Hybrid assistive limb. Case Study

UNIT V WEARABLE ROBOTS
Augmented Reality, Kinematics and Dynamics for Wearable Robots, Wearable Robot technology, Sensors, Actuators, Portable Energy Storage, Human–robot cognitive interaction (cHRI), Human–robot physical interaction (pHRI), Wearable Robotic Communication - case study

TOTAL:45 PERIODS

COURSE OUTCOMES:
CO1: Describe the configuration, applications of robots and the concept of grippers and actuators
CO2: Explain the functions of manipulators and basic kinematics
CO3: Describe the application of robots in various surgeries
CO4: Design and analyze the robotic systems for rehabilitation
CO5: Design the wearable robots

REFERENCES

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2</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>
</tr>
<tr>
<td>Avg</td>
<td>2</td>
<td></td>
<td>1.8</td>
<td></td>
<td>2.6</td>
<td>2.3</td>
</tr>
</tbody>
</table>

CO-PO Mapping
COURSE OBJECTIVES:

- To learn about the process involved in the design and development of real-time embedded system
- To develop the embedded C programming skills on 8-bit microcontroller
- To study about the interfacing mechanism of peripheral devices with 8-bit microcontrollers
- To learn about the tools, firmware related to microcontroller programming
- To build a home automation system

UNIT - I  INTRODUCTION TO EMBEDDED C PROGRAMMING  9
C Overview and Program Structure - C Types, Operators and Expressions - C Control Flow - C Functions and Program Structures - C Pointers And Arrays - FIFO and LIFO - C Structures - Development Tools

UNIT - II  AVR MICROCONTROLLER  9
ATMEGA 16 Architecture - Nonvolatile and Data Memories - Port System - Peripheral Features : Time Base, Timing Subsystem, Pulse Width Modulation, USART, SPI, Two Wire Serial Interface, ADC, Interrupts - Physical and Operating Parameters

UNIT – III  HARDWARE AND SOFTWARE INTERFACING WITH 8-BIT SERIES CONTROLLERS  9
Lights and Switches - Stack Operation - Implementing Combinational Logic - Expanding I/O - Interfacing Analog To Digital Convertors - Interfacing Digital To Analog Convertors - LED Displays : Seven Segment Displays, Dot Matrix Displays - LCD Displays - Driving Relays - Stepper Motor Interface - Serial EEPROM - Real Time Clock - Accessing Constants Table - Arbitrary Waveform Generation - Communication Links - System Development Tools

UNIT – IV  VISION SYSTEM  9

UNIT – V  HOME AUTOMATION  9
Home Automation - Requirements - Water Level Notifier - Electric Guard Dog - Tweeting Bird Feeder - Package Delivery Detector - Web Enabled Light Switch - Curtain Automation - Android Door Lock - Voice Controlled Home Automation - Smart Lighting - Smart Mailbox - Electricity Usage Monitor - Proximity Garage Door Opener - Vision Based Authentic Entry System

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

CO1: analyze the 8-bit series microcontroller architecture, features and pin details
CO2: write embedded C programs for embedded system application
CO3: design and develop real time systems using AVR microcontrollers
CO4: design and develop the systems based on vision mechanism
CO5: design and develop a real time home automation system

REFERENCES:

CX4016  ENVIRONMENTAL SUSTAINABILITY  L  T  P  C
UNIT I  INTRODUCTION 3 0 0 3
Valuing the Environment: Concepts, Valuing the Environment: Methods, Property Rights, Externalities, and Environmental Problems

UNIT II  CONCEPT OF SUSTAINABILITY 9
Sustainable Development: Defining the Concept, the Population Problem, Natural Resource Economics: An Overview, Energy, Water, Agriculture

UNIT III  SIGNIFICANCE OF BIODIVERSITY 9
Biodiversity, Forest Habitat, Commercially Valuable Species, Stationary - Source Local Air Pollution, Acid Rain and Atmospheric Modification, Transportation

UNIT IV  POLLUTION IMPACTS 9
Water Pollution, Solid Waste and Recycling, Toxic Substances and Hazardous Wastes, Global Warming.

UNIT V  ENVIRONMENTAL ECONOMICS 9
Development, Poverty, and the Environment, Visions of the Future, Environmental economics and policy by Tom Tietenberg, Environmental Economics

TOTAL : 45 PERIODS

REFERENCES

TX4092  TEXTILE REINFORCED COMPOSITES  L  T  P  C
UNIT I  REINFORCEMENTS 3 0 0 3
Introduction – composites –classification and application; reinforcements- fibres and its properties; preparation of reinforced materials and quality evaluation; preforms for various composites
UNIT II MATRICES
Preparation, chemistry, properties and applications of thermoplastic and thermoset resins; mechanism of interaction of matrices and reinforcements; optimization of matrices

UNIT III COMPOSITE MANUFACTURING
Classification; methods of composites manufacturing for both thermoplastics and thermosets- Hand layup, Filament Winding, Resin transfer moulding, prepregs and autoclave moulding, pultrusion, vacuum impregnation methods, compression moulding; post processing of composites and composite design requirements

UNIT IV TESTING
Fibre volume and weight fraction, specific gravity of composites, tensile, flexural, impact, compression, inter laminar shear stress and fatigue properties of thermoset and thermoplastic composites.

UNIT V MECHANICS
Micro mechanics, macro mechanics of single layer, macro mechanics of laminate, classical laminations theory, failure theories and prediction of inter laminar stresses using at ware

TOTAL: 45 PERIODS

REFERENCES

NT4002 NANOCOMPOSITE MATERIALS

UNIT I BASICS OF NANOCOMPOSITES

UNIT II METAL BASED NANOCOMPOSITES
Metal-metal nanocomposites, some simple preparation techniques and their properties. Metal- Oxide or Metal-Ceramic composites, Different aspects of their preparation techniques and their final
properties and functionality. Fractal based glass-metal nanocomposites, its designing and fractal dimension analysis. Core-Shell structured nanocomposites

UNIT III  POLYMER BASED NANOCOMPOSITES
Preparation and characterization of diblock Copolymer based nanocomposites; Polymer Carbon nanotubes based composites, their mechanical properties, and industrial possibilities.

UNIT IV  NANOCOMPOSITE FROM BIOMATERIALS
Natural nanocomposite systems - spider silk, bones, shells; organic-inorganic nanocomposite formation through self-assembly. Biomimetic synthesis of nanocomposites material; Use of synthetic nanocomposites for bone, teeth replacement.

UNIT V  NANOCOMPOSITE TECHNOLOGY

REFERENCES:
5. The search for novel, superhard materials- Stan Vepřek (Review Article) JVST A, 1999

TOTAL : 45 PERIODS

BY4016  IPR, BIOSAFETY AND ENTREPRENEURSHIP

UNIT I  IPR

UNIT II  AGREEMENTS, TREATIES AND PATENT FILING PROCEDURES

UNIT III BIO SAFETY

UNIT IV GENETICALLY MODIFIED ORGANISMS
Definition of GMOs & LMOs – Roles of Institutional Biosafety Committee – RCGM – GEAC etc. for GMO applications in food and agriculture – Environmental release of GMOs – Risk Analysis – Risk Assessment – Risk management and communication – Overview of National Regulations and relevant International Agreements including Cartegana Protocol.

UNIT V ENTREPRENEURSHIP DEVELOPMENT

REFERENCES