ANNA UNIVERSITY, CHENNAI
NON- AUTONOMOUS COLLEGES AFFILIATED ANNA UNIVERSITY
M.E. MANUFACTURING ENGINEERING
REGULATIONS 2021
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA & SYLLABI

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

| I.   | To prepare students to know and utilize the modern manufacturing facility in order to improve productivity. |
| II.  | To impart skills to use smart machines and apply latest technology in manufacturing field to innovate production process that will be useful to the Society |
| III. | To imbibe skills for integrated problem-solving techniques to optimize the Manufacturing resources for sustainable development |
| IV.  | To develop research attitude, new product, and process to solve problems in the field of manufacturing and to prepare the necessary reports. |

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>An ability to design systems, components, or processes meeting specified needs for the manufacturing industry and to improve its efficiency</td>
</tr>
<tr>
<td>5.</td>
<td>To use modern equipment and problem-solving tools for improving the manufacturing systems and processes in all aspects including technical, financial and management</td>
</tr>
<tr>
<td>6.</td>
<td>To pursue higher studies / pursue their career or entrepreneur in manufacturing and allied industries</td>
</tr>
</tbody>
</table>

3. PEO / PO Mapping:

<table>
<thead>
<tr>
<th>PEO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>II</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>III</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>IV</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Year</td>
<td>Semester</td>
<td>Course Name</td>
<td>PO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>----------</td>
<td>-------------------------------------------------------</td>
<td>-----</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Applied Probability and Statistics for Manufacturing</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>I</td>
<td>Engineering</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Advances in Manufacturing Processes</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Advances in Casting and Welding</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Theory of Metal Cutting</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Computer Aided Manufacturing</td>
<td>1.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Research Methodology and IPR</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Audit Course – I*</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CAD/CAM Laboratory</td>
<td>1.25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Technical Seminar</td>
<td>1.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>Optimization Techniques in Manufacturing</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>Advances in Metrology and Inspection</td>
<td>1.25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>Theory of Metal Forming</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>Additive Manufacturing</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>Fluid Power Automation</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>Professional Elective -I</td>
<td>1.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>Professional Elective -II</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>Audit Course – II*</td>
<td>1.6</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>Automation and Metal Forming Laboratory</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>II</td>
<td>Advanced Manufacturing Processes Laboratory</td>
<td>1.75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>Professional Elective –III</td>
<td>1.75</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>Professional Elective -IV</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>Professional Elective -V</td>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>Open Elective</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>III</td>
<td>Project Work I</td>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IV</td>
<td>Project Work II</td>
<td>2.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IV</td>
<td>Project Work II</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### SEMESTER I

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>MA4155</td>
<td>Applied Probability and Statistics for Manufacturing</td>
<td>FC</td>
<td>3 1 0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Engineering</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>MF4101</td>
<td>Advances in Manufacturing Processes</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>MF4102</td>
<td>Advances in Casting and Welding</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>MF4103</td>
<td>Theory of Metal Cutting</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>CM4151</td>
<td>Computer Aided Manufacturing</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>RM4151</td>
<td>Research Methodology and IPR</td>
<td>RMC</td>
<td>2 0 0</td>
<td>2</td>
<td>2</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>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>MF4111</td>
<td>CAD/CAM Laboratory</td>
<td>PCC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>9.</td>
<td>MF4112</td>
<td>Technical Seminar</td>
<td>EEC</td>
<td>0 0 2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>19 1 6</td>
<td>26</td>
<td>21</td>
</tr>
</tbody>
</table>

* Audit Course is optional

### SEMESTER II

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>MF4201</td>
<td>Optimization Techniques in Manufacturing</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>MF4202</td>
<td>Advances in Metrology and Inspection</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>MF4203</td>
<td>Theory of Metal Forming</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>MF4204</td>
<td>Additive Manufacturing</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>MF4205</td>
<td>Fluid Power Automation</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</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>
</tr>
<tr>
<td>7.</td>
<td></td>
<td>Professional Elective II</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td></td>
<td>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><strong>PRACTICALS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>MF4211</td>
<td>Automation and Metal Forming Laboratory</td>
<td>PCC</td>
<td>0 0 3</td>
<td>3</td>
<td>1.5</td>
</tr>
<tr>
<td>10.</td>
<td>MF4212</td>
<td>Advanced Manufacturing Processes Laboratory</td>
<td>PCC</td>
<td>0 0 3</td>
<td>3</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>23 0 6</td>
<td>29</td>
<td>24</td>
</tr>
</tbody>
</table>

* Audit Course is optional
## SEMESTER III

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>1.</td>
<td>Professional Elective III</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>Professional Elective IV</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>Professional Elective V</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>Open Elective</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

### PRACTICALS

<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>5.</td>
<td>MF4311</td>
<td>Project Work I</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
</tbody>
</table>

**TOTAL** | 12 | 0 | 12 | 24 | 18

---

## SEMESTER IV

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

**TOTAL** | 0 | 0 | 24 | 24 | 12

**TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 75**
## Foundation Courses (FC)

<table>
<thead>
<tr>
<th>SL. 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>MA4155</td>
<td>Applied Probability and Statistics for Manufacturing</td>
<td>3 1 0</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

## 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>1.</td>
<td>MF4101</td>
<td>Advances in Manufacturing Processes</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>MF4102</td>
<td>Advances in Casting and Welding</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>MF4103</td>
<td>Theory of Metal Cutting</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>CM4151</td>
<td>Computer Aided Manufacturing</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>MF4111</td>
<td>CAD/CAM Laboratory</td>
<td>PCC</td>
<td>0 0 4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>MF4201</td>
<td>Optimization Techniques in Manufacturing</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>MF4202</td>
<td>Advances in Metrology and Inspection</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>MF4203</td>
<td>Theory of Metal Forming</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>MF4204</td>
<td>Additive Manufacturing</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>MF4205</td>
<td>Fluid Power Automation</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>MF4211</td>
<td>Automation and Metal Forming Laboratory</td>
<td>PCC</td>
<td>0 0 3</td>
<td>3</td>
<td>1.5</td>
</tr>
<tr>
<td>12.</td>
<td>MF4212</td>
<td>Advanced Manufacturing Processes Laboratory</td>
<td>PCC</td>
<td>0 0 3</td>
<td>3</td>
<td>1.5</td>
</tr>
</tbody>
</table>

## Research Methodology and IPR Courses (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 0 0</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

TOTAL CREDITS: 2
# PROFESSIONAL ELECTIVES FOR M.E. MANUFACTURING ENGINEERING

## SEMESTER II, ELECTIVES - I & 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>MF4071</td>
<td>Design for Manufacture and Assembly</td>
<td>PEC</td>
<td>0 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>MF4001</td>
<td>Micro Manufacturing</td>
<td>PEC</td>
<td>0 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>MF4002</td>
<td>Quality and Reliability Engineering</td>
<td>PEC</td>
<td>0 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>MF4003</td>
<td>Finite Element Methods for Manufacturing Engineering</td>
<td>PEC</td>
<td>0 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>MF4004</td>
<td>Materials Management</td>
<td>PEC</td>
<td>0 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>MF4005</td>
<td>Industrial Ergonomics</td>
<td>PEC</td>
<td>0 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>MF4006</td>
<td>Polymers and Composite Materials</td>
<td>PEC</td>
<td>0 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>MF4092</td>
<td>Non-Destructive Testing</td>
<td>PEC</td>
<td>0 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>MF4007</td>
<td>Lean Manufacturing</td>
<td>PEC</td>
<td>0 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>MF4008</td>
<td>Robot Design and Programming</td>
<td>PEC</td>
<td>0 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>MF4009</td>
<td>MEMS and Nanotechnology</td>
<td>PEC</td>
<td>0 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>CM4091</td>
<td>Green Manufacturing</td>
<td>PEC</td>
<td>0 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>SL. NO.</td>
<td>COURSE CODE</td>
<td>COURSE TITLE</td>
<td>CATEGORY</td>
<td>PERIODS PER WEEK</td>
<td>TOTAL CONTACT PERIODS</td>
<td>CREDITS</td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td>--------------------------------------------------</td>
<td>----------</td>
<td>------------------</td>
<td>------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>1.</td>
<td>MF4010</td>
<td>Computer Aided Product Design</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>MF4011</td>
<td>Process Planning and Cost Estimation</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>MF4091</td>
<td>Manufacturing Management</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>MF4012</td>
<td>Nanotechnology</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>MF4013</td>
<td>Materials Testing and Characterization Techniques</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>MF4014</td>
<td>Mechatronics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>MR4071</td>
<td>Internet of Things for Manufacturing</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>IS4071</td>
<td>Data Analytics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>CM4071</td>
<td>Manufacturing System Simulation</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>PD4391</td>
<td>Product Lifecycle Management</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>MF4015</td>
<td>Product Design and Development</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>MF4016</td>
<td>Entrepreneurship Development</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>13.</td>
<td>MF4020</td>
<td>Industrial Safety</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>14.</td>
<td>MF4017</td>
<td>Advances in Materials</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>15.</td>
<td>MF4018</td>
<td>Artificial Intelligence</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>16.</td>
<td>MF4019</td>
<td>Smart Manufacturing</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</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 L 0 T 0 P</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>AX4092</td>
<td>Disaster Management</td>
<td>2 L 0 T 0 P</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>AX4093</td>
<td>Constitution of India</td>
<td>2 L 0 T 0 P</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>AX4094</td>
<td>நற்றமிழ் இலக்கியம்</td>
<td>2 L 0 T 0 P</td>
<td>0</td>
</tr>
</tbody>
</table>

# EMPLOYABILITY ENHANCEMENT COURSES (EEC)

<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></td>
<td>MF4112</td>
<td>Technical Seminar</td>
<td>0 L 0 T 2 P</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1.</td>
<td>MF4311</td>
<td>Project Work - I</td>
<td>0 L 0 12 T</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>MF4411</td>
<td>Project Work-II</td>
<td>0 L 0 24 T</td>
<td>12</td>
<td>4</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 L 0 T 0 P</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>OCE432</td>
<td>Water, Sanitation and Health</td>
<td>3 L 0 T 0 P</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>OCE433</td>
<td>Principles of Sustainable Development</td>
<td>3 L 0 T 0 P</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>OCE434</td>
<td>Environmental Impact Assessment</td>
<td>3 L 0 T 0 P</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>OIC431</td>
<td>Blockchain Technologies</td>
<td>3 L 0 T 0 P</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>OIC432</td>
<td>Deep Learning</td>
<td>3 L 0 T 0 P</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>OBA431</td>
<td>Sustainable Management</td>
<td>3 L 0 T 0 P</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>OBA432</td>
<td>Micro and Small Business Management</td>
<td>3 L 0 T 0 P</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>OBA433</td>
<td>Intellectual Property Rights</td>
<td>3 L 0 T 0 P</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>OBA434</td>
<td>Ethical Management</td>
<td>3 L 0 T 0 P</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>ET4251</td>
<td>IoT for Smart Systems</td>
<td>3 L 0 T 0 P</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>ET4072</td>
<td>Machine Learning and Deep Learning</td>
<td>3 L 0 T 0 P</td>
<td>3</td>
</tr>
<tr>
<td>13.</td>
<td>PX4012</td>
<td>Renewable Energy Technology</td>
<td>3 L 0 T 0 P</td>
<td>3</td>
</tr>
<tr>
<td>14.</td>
<td>PS4093</td>
<td>Smart Grid</td>
<td>3 L 0 T 0 P</td>
<td>3</td>
</tr>
<tr>
<td>15.</td>
<td>CP4391</td>
<td>Security Practices</td>
<td>3 L 0 T 0 P</td>
<td>3</td>
</tr>
<tr>
<td>16.</td>
<td>MP4251</td>
<td>Cloud Computing Technologies</td>
<td>3 L 0 T 0 P</td>
<td>3</td>
</tr>
<tr>
<td>17.</td>
<td>IF4072</td>
<td>Design Thinking</td>
<td>3 L 0 T 0 P</td>
<td>3</td>
</tr>
<tr>
<td>18.</td>
<td>MU4153</td>
<td>Principles of Multimedia</td>
<td>3 L 0 T 0 P</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
<td>ECTS</td>
</tr>
<tr>
<td>---</td>
<td>-------------</td>
<td>---------------------------------------------------</td>
<td>---------</td>
<td>------</td>
</tr>
<tr>
<td>19.</td>
<td>DS4015</td>
<td>Big Data Analytics</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>20.</td>
<td>NC4201</td>
<td>Internet of Things and Cloud</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>21.</td>
<td>MX4073</td>
<td>Medical Robotics</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>22.</td>
<td>VE4202</td>
<td>Embedded Automation</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>23.</td>
<td>CX4016</td>
<td>Environmental Sustainability</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>24.</td>
<td>TX4092</td>
<td>Textile Reinforced Composites</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>25.</td>
<td>NT4002</td>
<td>Nanocomposite Materials</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>26.</td>
<td>BY4016</td>
<td>IPR, Biosafety and Entrepreneurship</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>
MA4155  APPLIED PROBABILITY AND STATISTICS FOR MANUFACTURING ENGINEERING

L    T    P   C
3    1    0    4

COURSE OBJECTIVES:
1. To understand the basics of random variables with emphasis on the standard discrete and continuous distributions.
2. To understand the basic probability concepts with respect to two dimensional random variables along with the relationship between the random variables.
3. To apply the small and large sample tests through test of hypothesis.
4. To understand the basic concepts of sampling distributions and statistical properties of point estimators.
5. To understand the concept of analysis of variance and use it to investigate factorial dependence.

UNIT I  PROBABILITY AND RANDOM VARIABLES  12

UNIT II  TWO DIMENSIONAL RANDOM VARIABLES  12
Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

UNIT III  TESTING OF HYPOTHESIS  12
Sampling distributions - Type I and Type II errors - Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit.

UNIT IV  ESTIMATION THEORY  12
Interval estimation for population mean - Standard deviation - Difference in means, proportion ratio of standard deviations and variances.

UNIT V  DESIGN OF EXPERIMENTS  12
Completely randomized design – Randomized block design – Latin square design – $2^2$ Factorial design.

COURSE OUTCOMES:
At the end of the course, students will be able to
- Analyze the performance in terms of probabilities and distributions achieved by the determined solutions.
- Be familiar with some of the commonly encountered two dimensional random variables and be equipped for a possible extension to multivariate analysis.
- Apply the basic principles underlying statistical inference (hypothesis testing).
- Demonstrate knowledge of applicable large sample theory of estimators and tests.
- Obtain a better understanding of the importance of the methods in modern industrial processes.
REFERENCES:

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

MF4101 ADVANCES IN MANUFACTURING PROCESSES L T P C 3 0 0 3

OBJECTIVES:
1. To inculcate specialized knowledge and skill in advanced manufacturing processes using the principles and methods of engineering analysis and design.
2. To impart knowledge about the significance of controlling process parameters for the optimal performance for newly developed engineering materials used in industries and research organizations.
3. To impart knowledge about principles and criteria of yielding during forming of metals, analysis of different bulk metal forming processes following different analysis approach.
4. To give awareness of different techniques used in Micro and Nano manufacturing.
5. To introduce students the basics of rapid prototyping and its applications in various fields, reverse engineering techniques.

UNIT I ENERGY ASSISTED MANUFACTURING PROCESSES 9
Introduction – mechanism of materials removal and operating parameters of: Plasma Arc Machining – Laser Beam Machining – Electron Beam Machining – Electrical Discharge Machining – Ultrasonic Machining – Water Jet Machining – Abrasive water jet Machining – Abrasive jet Machining – Ion Beam Machining.

UNIT II PRECISION MACHINING 9
UNIT III ADVANCES IN METAL FORMING
Orbital forging, Isothermal forging, Warm forging, Overview of Powder Metal techniques – Hot and Cold isostatic pressing - high speed extrusion, rubber pad forming, Hydroforming, Superplastic forming, Peen forming - micro blanking – Powder rolling – Tooling and process parameters.

UNIT IV MICRO MACHINING AND NANO FABRICATION

UNIT V RAPID PROTOTYPING AND SURFACE MODIFICATION TECHNIQUES

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, students will be able to
1. Analyze the processes and evaluate the role of each process parameter during machining of various advanced materials.
2. Understand requirements to achieve maximum material removal rate and best quality of machined surface while machining various industrial engineering materials.
3. Analyze the different bulk metal forming process mechanics using different analysis
4. Acquire the knowledge in mechanical micromachining processes.
5. Demonstrate the knowledge of Additive Manufacturing and Rapid Prototyping Technologies

REFERENCES

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

MF4102 ADVANCES IN CASTING AND WELDING

L T P C
3 0 0 3
COURSE OBJECTIVES:
1. To study the metallurgical concepts and applications of casting and welding process.
2. To acquire knowledge in CAD of casting and automation of the welding process.
3. To know various solid state and special welding processes.
4. To introduce metallurgy of welding.
5. To design the weldments for various materials. To gain knowledge on various welding defects and inspection methods.

UNIT I CASTING DESIGN
Heat transfer between metal and mould — Design considerations in casting – Designing for directional solidification and minimum stresses - principles and design of gating and riser-Melting and casting quality

UNIT II CASTING METALLURGY

UNIT III RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT
Shell moulding, precision investment casting, CO2 moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry – sand reclamation – material handling in foundry pollution control in foundry — Computer aided design of casting.

UNIT IV WELDING METALLURGY AND DESIGN

UNIT V RECENT TRENDS IN WELDING

COURSE OUTCOMES:
● At the end of this course the students are expected to impart knowledge on basic concepts and advances in casting and welding processes.
● Know and perform solid state and special welding processes.
● Understand and analyze the material structures after welding.
● Design the weldments for various materials.
● Attain the knowledge about various welding defects and inspection methods.

TOTAL: 45 PERIODS

REFERENCES:
1. ASM Handbook vol.6, welding Brazing & Soldering, 2010

**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>1</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Avg.</td>
<td>1.33</td>
<td>-</td>
<td>2.5</td>
<td>3</td>
<td>2</td>
<td>1.33</td>
</tr>
</tbody>
</table>

**MF4103**

**THEORY OF METAL CUTTING**

<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>

**OBJECTIVES:**
1. To make the students to familiar with the basic principles of metal cutting
2. To familiarise the students various cutting tool materials and its wear mechanisms during the machining operation.
3. Differentiate between single point and multi point cutting tools.
4. To study the heat generation during machining and the necessity for cutting fluid
5. To study the effect of vibrations during machining

**UNIT I**

*INTRODUCTION*

Need for rational approach to the problem of cutting materials-observation made in the cutting of metals-basic mechanism of chip formation-thin and thick zone modes-types of chips-chip breaker-orthogonal Vs oblique cutting-force velocity relationship for shear plane angle in orthogonal cutting-energy consideration in machining-review of Merchant, Lee and Shafter theories-critical comparison.

**UNIT II**

*SYSTEM OF TOOL NOMENCLATURE*

Nomenclature of single point cutting tool and nomenclature of multi point cutting tools – Twist Drill – milling cutter - System of tool nomenclature and conversion of rake angles-nomenclature of multi point tools like drills, milling-conventional Vs climb milling, mean cross sectional area of chip in milling-specific cutting pressure.

**UNIT III**

*THERMAL ASPECTS OF MACHINING*

Heat distribution in machining-effects of various parameters on temperature-methods of temperature measurement in machining-hot machining- Cutting fluid – properties – types of cutting fluids – Selection of cutting fluids.
UNIT IV TOOL MATERIALS, TOOL LIFE AND TOOL WEAR


UNIT V WEAR MECHANISMS AND CHATTER IN MACHINING


COURSE OUTCOMES:
At the end of the course students will be familiar with
- Basics of orthogonal cutting, oblique cutting and chip formation
- Different tool materials, tool life and tool wear mechanisms
- Necessity for a cutting fluid and cutting efficiency
- Single and Multipoint cutting tools
- Effect of vibrations and surface roughness during machining

TOTAL: 45 PERIODS

REFERENCES

CM4151 COMPUTER AIDED MANUFACTURING

COURSE OBJECTIVES:
1. To introduce the evolution of CAD, CAM, CIM, engineering product specification and interpreting geometric specifications.
2. To train the candidates on the integration of Computer Aided Design and Computer Aided Manufacturing.
3. To impart knowledge on manual part program and generation of CNC part program using Computer Aided Manufacturing packages.
4. To introduce with the implementation of CAD and CAM in manufacturing process.
5. To introduce the importance of Internet of Things in Computer Aided Manufacturing.

UNIT I INTRODUCTION TO CAM

Introduction CAD, CAM, CAE, CIM, system configuration for CAM including hardware and software, evolution of product realization, historical development, engineering product specification. Geometric Tolerancing - ASME standard, interpreting geometric specifications, multiple part features and datum.

UNIT II CAD AND CAM INTEGRATION
Introduction - Networking - Techniques, components, interface cards, network standards, Graphics standards -
Graphical kernel system, Data exchange format - IGES and STEP.
Process planning, Computer Aided Process Planning (CAPP), Product life cycle management (PLM), Enterprise
resource planning (ERP).

UNIT III PROGRAMMING OF CNC MACHINES 9
Structure of CNC program, Coordinate system, G & M codes, cutter radius compensation, tool nose radius
compensation, tool wear compensation, canned cycles, mirroring features, Manual part programming for CNC
turning, machining center, wire electric discharge machining, abrasive water jet cutting machine, bulk and sheet
metal forming, generation of CNC program using CAM softwares.

UNIT IV CAD AND CAM FOR MANUFACTURING PROCESSES 9
Classification of Manufacturing process, construction and operations, Integration of CAD and CAM in CNC turning
center, machining center, electric discharge machining, wire electric discharge machining, abrasive water jet cutting
machine, bulk forming, sheet metal forming.

UNIT V IOT IN CAM 9
Introduction, overview of IOT enabled manufacturing system, Real-time and multi-source manufacturing
information sensing system, IOT enabled smart assembly station, cloud computing based manufacturing resources
configuration method, Real-time key production performances analysis method, Real-time information driven
production scheduling system.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students shall be able to:
CO1: Recognize the importance of CAD, CAM, CIM, Engineering product specification and
interpreting geometric specifications.
CO2: Improve knowledge on the integration of CAD and CAM.
CO3: Exhibit competency in manual part program and generation of CNC part program using CAM packages.
CO4: Describe the implementation of CAD and CAM in manufacturing processes.
CO5: Explain applications of IOT in computer aided manufacturing.

REFERENCES:
   United Kingdom, 2012.
6. Yingfeng Zhang and Fei Tao, “Optimization of Manufacturing Systems Using the Internet of

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

MF4111 CAD / CAM LABORATORY  
\[L\ T\ P\ C\]
\[0\ 0\ 4\ 2\]

COURSE OBJECTIVES:
1. To introduce components and assemblies used in machines and use of 3D parametric CAD, CAM software for mechanical design.
2. To provide an experiential learning environment using projects done by student groups, while applying CAD, CAE software tools to design mechanisms and structures for mechanical design evaluation,
optimization of mass properties, static-stresses, deformations, etc. with experimental validation of simulation models.

3. To do some exercises in tool pre-setting and work piece referencing on CNC machine tools, manual part programming for CNC turning and milling centres.

4. Use of software for simulation of turned and milled parts and simple surfaces, Automatic Cutter location data generation from CAD Models in APT format and post-processing for machining on CNC machines using standard CAD/CAM software.

5. To produce an industrial component and measure to verify its conformity with the design.

**CAM LABORATORY**

1. Exercise on CNC Lathe: Plain Turning, Step turning, Taper turning, Threading, Grooving canned cycle.
4. Mechanical Drawing: Machining and surface finish symbols and tolerances in dimensioning.
5. CAD: Introduction to CAD, CAM, software in product life cycle.

**CAD LABORATORY**

2D modelling and 3D modelling of components such as

1. Bearing
2. Couplings
3. Gears
4. Sheet metal components
5. Jigs, Fixtures and Die assemblies.

**TOTAL: 60 PERIODS**

**COURSE OUTCOMES:**
At the end of this course the students are expected to:

1. Interpret mechanical drawings for components, assemblies and use parametric 3D CAD software tools in the correct manner for creating their geometric part models, assemblies and automated drawings.
2. Apply the concepts of machining for the purpose of selection of appropriate machining centres, machining parameters, select appropriate cutting tools for CNC milling and turning equipment, set-up, program, and operate CNC milling and turning equipment.
3. Create and validate NC part program data using manual data input (MDI) and automatically using standard commercial CAM package for manufacturing of required component using CNC milling or turning applications.
4. Produce an industrial component by interpreting 3D part model/ part drawings using Computer Aided Manufacturing technology through programming, setup, and ensuring safe operation of Computer Numerical Control (CNC) machine tools.
5. Create and demonstrate the technical documentation for design/ selection of suitable drive technologies, precision components and an overall CNC machine tool system for automation of machining operations using appropriate multi-axis CNC technology.
OBJECTIVES:
(1) To enrich the communication skills of the student through presentation of topics in recent advances in engineering/technology
(2) To ensure that students possess a comprehensive understanding of the latest development in his chosen area
(3) To ensure that students are getting updated with latest technology

A group of 2 students have to choose a problem and carry out scientific systematic investigation experimentally/theoretically in suggesting a viable solution. At the end of the semester, each group of students have to submit a report for evaluation.

Depth of understanding, coverage, quality of presentation material (PPT/OHP) and communication skill of the student will be taken as measures for evaluation.

OUTCOMES:
At the end of this course the students are expected:
(1) To develop skills to search, read, write, comprehend and present research papers in the areas of manufacturing engineering.
(2) Updated with the latest technology in the field of Manufacturing Engineering
(3) Able to plot graph, sketch, bring out the visual about his understanding on various topics

TOTAL: 30 PERIODS
OBJECTIVES:
1) To make use of the optimization techniques while modelling and solving the engineering problems of different fields.
2) To apply Linear Programming and Dynamic Programming to provide solutions for different problems.
3) Learn classical optimization techniques and numerical methods of optimization.
4) Know the basics of different evolutionary algorithms.
5) To understand and differentiate traditional and non-traditional methods of Optimization.

UNIT I INTRODUCTION

UNIT II CLASSIC OPTIMIZATION TECHNIQUES

UNIT III NON-LINEAR PROGRAMMING

UNIT IV INTEGER PROGRAMMING AND DYNAMIC PROGRAMMING AND NETWORK TECHNIQUES

UNIT V ADVANCES IN SIMULATION
Genetic algorithms – simulated annealing – Neural Network and Fuzzy systems.

TOTAL: 45 PERIODS

OUTCOMES:
1) At the end of this course the students will be expected to introduce the various optimization techniques and their advancements.
2) Ability to go in research by applying optimization techniques in problems of Engineering and Technology.
3) Use classical optimization techniques and numerical methods of optimization.
4) Describe the basics of different evolutionary algorithms.
5) Ability to solve the mathematical results and numerical techniques of optimization theory to concrete Engineering problems by using computer software.

REFERENCES:
OBJECTIVES:
1) To teach the students basic concepts in various methods of engineering measurement techniques and applications
2) To make them understand the importance of measurement and inspection in manufacturing industries.
3) To understand the use of Light rays and Laser beams for measurement and their merits
4) To make the students capable of learning to operate and use advanced metrological devices with ease in industrial environments.
5) To teach the use of computer for measuring and processing of measured quantity

UNIT I CONCEPTS OF METROLOGY
Terminologies – Standards of measurement – Errors in measurement – Interchangeability and Selective assembly – Accuracy and Precision – Calibration of instruments – Basics of Dimensional metrology and Form metrology

UNIT II MEASUREMENT OF SURFACE ROUGHNESS

UNIT III INTERFEROMETRY

UNIT IV MEASURING MACHINES AND LASER METROLOGY

UNIT V IMAGE PROCESSING FOR METROLOGY
Overview, Computer imaging systems, Image Analysis, Pre-processing, Human vision system, Image model, Image enhancement, grey scale models, histogram models, Image Transforms - Examples.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are expected to
1. Understand the advanced measurement principles with ease.
2. Operate sophisticated and accurate measuring instruments.
3. Understand the various inspection methods and tools
4. Design and develop new measuring methods.
5. Apply computers in Measurement

REFERENCES

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>1</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td></td>
<td>3</td>
<td></td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Avg.</td>
<td>1</td>
<td></td>
<td>3</td>
<td>1</td>
<td>1.75</td>
<td>1.25</td>
</tr>
</tbody>
</table>

MF4203 THEORY OF METAL FORMING

OBJECTIVES:
1) To study the basic concepts of metal forming techniques and to develop force calculation in metal forming process.
2) To study the thermo mechanical regimes and its requirements of metal forming
3) To learn the art of processing and making of powder metallurgy components
4) To learn the effect of friction and lubrication in Metal forming
5) To study the various surface treatment processes

UNIT I THEORY OF PLASTICITY
UNIT II THEORY AND PRACTICE OF BULK FORMING PROCESSES


UNIT III SHEET METAL FORMING

Formability studies – Conventional processes – H E R F techniques – Superplastic forming techniques – Hydro forming – Stretch forming – Water hammer forming – Principles and process parameters – Advantages, Limitations and applications

UNIT IV POWDER METALLURGY AND SPECIAL FORMING PROCESSES


UNIT V SURFACE TREATMENT AND METAL FORMING APPLICATIONS


OUTCOMES:

1) At the end of this course the students are expected to upgrade their knowledge on various metal forming techniques and formability
2) Apply the theory of plasticity for various types of metal forming process.
3) Apply the concept of powder metallurgy to make prismatic components
4) Understand Non-traditional forming processes.
5) Understand the purpose of surface treatment in metal forming applications

TOTAL: 45 PERIODS

REFERENCES:

10. Surender Kumar, Technology of Metal Forming Processes, Prentice Hall India Publishers, 2010
CO-PO Mapping

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

MF4204 ADDITIVE MANUFACTURING

OBJECTIVES:
1) To educate students with fundamental and advanced knowledge in the field of Additive manufacturing technology
2) Gain insights on the need, advantages and limitations of additive manufacturing (AM) versus traditional manufacturing
3) Find out the various applications of AM. Deployment levels. Innovative and optimized product design
4) To explore the potential of additive manufacturing in different industrial sectors.
5) To apply 3D printing technology for additive manufacturing.

UNIT I INTRODUCTION

UNIT II REVERSE ENGINEERING AND CAD MODELLING

UNIT III LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS

UNIT IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS

UNIT V OTHER ADDITIVE MANUFACTURING SYSTEMS

Three-dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition Manufacturing (SDM), Ballastic Particle Manufacturing (BPM), Selective Laser Melting, Electron Beam Melting.

TOTAL: 45 PERIODS

OUTCOMES:
1) The students are expected to learn about a variety of Additive Manufacturing (AM) technologies.
2) Describe additive manufacturing and explain its advantages and disadvantages
3) Explain the processes used in additive manufacturing for a range of materials and applications
4) understand the role of additive manufacturing in the design process and their potential to support Design and manufacturing,
5) Case studies relevant to mass customized manufacturing, and some of the important research challenges associated with AM and its data processing tools

REFERENCES:
OBJECTIVES:
1) To make the students to learn the basic concepts of hydraulics and pneumatics and their controlling elements in the area of manufacturing process.
2) To train the students in designing the hydraulic and pneumatic circuits using various design procedures.
3) To understand the concept and principle operation of automation systems and their controls.
4) To provide knowledge levels needed for PLC programming and operating
5) Ability to implement automation systems in Industry

UNIT I INTRODUCTION

UNIT II FLUID POWER GENERATING/UTILIZING ELEMENTS

UNIT III CONTROL AND REGULATION ELEMENTS
Direction flow and pressure control valves-Methods of actuation, types, sizing of ports-pressure and temperature compensation, overlapped and underlapped spool valves-operating characteristics-electro hydraulic servo valves, Digital valves -Different types-characteristics and performance.

UNIT IV CIRCUIT DESIGN

UNIT V ELECTRO PNEUMATICS & ELECTRONIC CONTROL OF HYDRAULIC AND PNEUMATIC CIRCUITS
Electrical control of pneumatic and hydraulic circuits-use of relays, timers, counters, Ladder diagram. Programmable logic control of Hydraulics Pneumatics circuits, PLC ladder diagram for various circuits, motion controllers, use of field busses in circuits. Electronic drive circuits for various Motors.

TOTAL: 45 PERIODS
OUTCOMES:
1) At the end of this course the students are familiarized in the area of hydraulics, pneumatic and fluid power components and its functions.
2) Recognize the standard symbols used in fluid power circuits and assess the suitable component for a particular application
3) Construct the hydraulic circuits for an industrial application.
4) Build a pneumatic circuit and apply them to real life problems.
5) Design and develop a PLC controlled pneumatic circuit for industrial application

REFERENCES:

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>1</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Avg.</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2.5</td>
</tr>
</tbody>
</table>

MF4211 AUTOMATION AND METAL FORMING LABORATORY L T P C
0 0 3 1.5

OBJECTIVES
1) To train the students on the basic concepts of metal forming processes
2) To determine metal forming parameters for a given shape.
3) To learn the automation systems using fluid power control systems
4) To learn and use automation studio software
5) To learn PLC and its importance in Fluid power applications

EXPERIMENTS
1. Determination of strain hardening exponent
2. Determination of strain rate sensitivity index
3. Construction of formability limit diagram
4. Determination of efficiency in water hammer forming
5. Determination of interface friction factor
6. Determination of extrusion load
7. Study on two high rolling process
AUTOMATION LAB
1. Simulation of single and double acting cylinder circuits
2. Simulation of Hydraulic circuits
3. Simulation of electro pneumatic circuits
4. Simulation of electro hydraulic circuits
5. Simulation of PLC circuits

OUTCOMES:
At the end of this course the students are expected
1) To impart practical knowledge on bulk metal forming processes
2) Know various symbols used in Hydraulic and Pneumatic circuits
3) Conduct few sheet metals forming processes and analyse the parameters
4) Design hydraulic circuits for industrial applications
5) Learnt how to use automation studio

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>-</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Avg.</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2.33</td>
<td>1</td>
</tr>
</tbody>
</table>

MF4212  ADVANCED MANUFACTURING PROCESSES LABORATORY
(Students can do any three sets for this lab out of the given four i.e. I, II, III, IV) 0 0 3 1.5

COURSE OBJECTIVES
(1) To analyses the forces in machining
(2) To perform modelling and simulation of manufacturing processes
(3) To develop product using rapid prototyping
(4) To program a robot for an autonomous movement
(5) To analyze product Life cycle

I  ADVANCED MACHINING PROCESS
(1) Analysis of cutting forces during turning/drilling process.
(2) Analysis of temperature during turning/drilling process.
(3) Study on the effect of process parameters in Electro-Chemical/Electric-Discharge Machining

II  PROCESS MODELLING
1. Analysis of stress strain distribution in a structural loading of composite bar using MATLAB codes.
2. Transient heat transfer analysis of a rectangular slab using a FEA package.
III RAPID PROTOTYPING
(1) Selection of Rapid Prototyping Technology.
(2) Product development activity – Concept design and Detailed design.
(3) Product development activity – Engineering analysis and Prototype development.

IV ROBOTICS
(1) Determination of maximum and minimum position of links.
(2) Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
(3) Estimation of accuracy, repeatability and resolution.
(4) Robot programming and simulation for pick and place
(5) Robot programming and simulation for Color identification
(6) Robot programming and simulation for Shape identification

COURSE OUTCOMES:
1. Perform modelling and simulation of manufacturing processes
2. Analyze the process using an FEA package
2. Competence to execute product development phases
3. Simple programming for robotic applications
4. Use EDM/ECM for machining different materials

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

MF4311 PROJECT WORK I

OBJECTIVES:
(1) To develop knowledge to formulate a real-world problem.
(2) To break up the goal and evolve procedures
(3) To use different tools and techniques to arrive at a solution
(4) To validate the results analytically and experimentally
(5) To prepare a report and give a presentation

Student shall identify a minor problem related to the field of Manufacturing and carry out a literature survey/case studies/data collection. Student is supposed to formulate Engineering solutions to the problem, methodology to test their hypothesis/solutions and validate it theoretically/practically, planned and executed within the stipulated time.

Observations, results and inference should be documented and presented as report in the prescribed format.

TOTAL: 180 PERIODS
OUTCOMES
After successful completion of this course, the students should be able to
(1) Design and analyze, an identified problem using scientific tools
(2) Simulation/ Theoretical analysis of a physical system
(3) Integrate various domain knowledge for a sustainable solution.
(4) Set Goals, Targets, timeline, plan and execute activities of the project
(5) Disseminate work both in oral and written format.

CO-PO Mapping

<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>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg</td>
<td>1.75</td>
<td>2</td>
<td>2.5</td>
<td>2.5</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

MF4411 PROJECT WORK II

OBJECTIVES:
(1) To develop knowledge to formulate a real-world problem.
(2) To break up the goal and evolve procedures
(3) To use different tools and techniques to arrive at a solution
(4) To validate the results analytically and experimentally
(5) To prepare a report and give a presentation

Student shall identify a major/critical problem related to the field of Manufacturing and carry out a literature survey/case studies/data collection. Student supposed to formulate Engineering solutions to set objectives, methodology to test their hypothesis/solutions and validate it theoretically/practically, planned and executed within the stipulated time.

Observations, results and inferences should be documented and presented as report in the prescribed format.

TOTAL: 360 PERIODS

OUTCOMES
After successful completion of this course, the students should be able to
(1) Design and analyze, an identified problem using scientific tools and research
(2) simulation/ Theoretical analysis of a physical system
(3) Integrate various domain knowledge in carrying out experimental work and provide a sustainable solution.
(4) Set Goals, Targets, timeline, plan and execute activities of the project
(5) Disseminate work both in oral and written format.
MF4071 DESIGN FOR MANUFACTURE AND ASSEMBLY  L T P C  3 0 0 3

OBJECTIVES:
(1) To apply various design rules in manufacturing processes
(2) To evaluate the process by design guidelines for optimum design
(3) To analyze the rules of concepts of GD&T
(4) To make the students to learn about tolerance analysis and allocation, geometrical tolerances
(5) Guidelines for design for manufacturing and assembly with suitable examples.

UNIT I TOLERANCE ANALYSIS 9

UNIT II TOLERANCE ALLOCATION 9

UNIT III GD&T 9

UNIT IV TOLERANCE CHARTING 9

UNIT V MANUFACTURING GUIDELINES 9

OUTCOMES:

TOTAL: 45 PERIODS
At the end of this course the students are expected
(1) To impart the knowledge about the significance of design for manufacturing and assembly
(2) To apply the principle of tolerancing in design
(3) To evaluate the process of GD & T using design guidelines
(4) To apply tolerance allocation and tolerance charting in design
(5) To apply guidelines for manufacturing and assembly

REFERENCES:

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>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Avg</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2.25</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

MF4001 MICRO MANUFACTURING L T P C

OBJECTIVES:
(1) The objective of the course is to acquaint the students with the principles of micro manufacturing
(2) To learn basic machine tools used in micro manufacturing and developments in the micro manufacturing process
(3) To familiarize with the research trends in the area of micro manufacturing process.
(4) To learn various polishing techniques
(5) To study the various measuring techniques used for micro/nano components

UNIT I MECHANICAL MICRO MACHINING

UNIT II BEAM ENERGY BASED MICRO MACHINING

UNIT III NANO POLISHING

UNIT IV MICRO FORMING AND WELDING

UNIT V RECENT TRENDS AND APPLICATIONS

OUTCOMES:
At the end of this course the students are well experienced
(1) To impart the principles of various basic micro manufacturing process
(2) To know and perform micro machining
(3) Research various micro machining process to optimize the process variables
(4) Attain knowledge about polishing techniques
(5) Measure and analyse the various parameters of micro machined components

TOTAL: 45 PERIODS

REFERENCES:
8. www.cmrx.com/industrial/

CO-PO Mapping

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

MF4002 QUALITY AND RELIABILITY ENGINEERING

OBJECTIVES:
To make the students construct the various quality control charts for variables and attributes
To study the various sampling plans

L T P C
3 0 0 3

MF4002 QUALITY AND RELIABILITY ENGINEERING

OBJECTIVES:
To make the students construct the various quality control charts for variables and attributes
To study the various sampling plans

L T P C
3 0 0 3
To make the students design for reliability
To learn different methods of improving reliability
To learn the basics of maintainability.

UNIT I QUALITY & STATISTICAL PROCESS CONTROL 9

UNIT II ACCEPTANCE SAMPLING 9

UNIT III EXPERIMENTAL DESIGN AND TAGUCHI METHOD 9

UNIT IV CONCEPT OF RELIABILITY 9
Definition – reliability vs quality, reliability function – MTBF, MTTR, availability, bathtub curve – time dependent failure models – distributions – normal, Weibull, lognormal – Reliability of system and models – serial, parallel and combined configuration – Markov analysis, load sharing systems, standby systems, covariant models, static models, dynamic models.

UNIT V DESIGN FOR RELIABILITY AND MAINTAINABILITY 9
Reliability design process, system effectiveness, economic analysis and life cycle cost, reliability allocation, design methods, parts and material selection, derating, stress-strength and analysis, failure analysis, identification determination of causes, assessments of effects, computation of criticality index, corrective action, system safety – analysis of down-time – the repair time distribution, stochastic point processes system repair time, reliability under preventive maintenance state dependent system with repair. MTTR – mean system down time, repair vs replacement, replacement models, proactive, preventive, predictive maintenance maintainability and availability, optimization techniques for system reliability with redundancy heuristic methods applied to optimal system reliability.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are exposed to the various quality control techniques, to understand the importance and concept of reliability and maintainability in industries.

(1) Apply control chart techniques in production process
(2) Understand inspection by sampling techniques
(3) Able to do reliable design
(4) Improve the availability of equipment through proper maintenance
(5) Know how to improve the 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>-</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>-</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>2.25</td>
<td>1.5</td>
<td>1.33</td>
</tr>
</tbody>
</table>

**MF4003**  
**FINITE ELEMENT METHODS FOR MANUFACTURING**  
**ENGINEERING**  
3 0 0 3

**OBJECTIVES:**
1. To familiarize the students with fundamentals of finite element method,
2. To study the fundamentals of one dimensional and two dimensional problems using FEA in manufacturing,
3. Acquaint students with finite element formulations and theories,
4. Develop the ability to perform finite element analyses and evaluate the results of a select set of manufacturing processes,
5. Provide exposure to practical problems and their solutions, through simulations using the finite element software

**UNIT I  INTRODUCTION**  
Fundamentals – Initial, boundary and eigen value problems – weighted residual, Galerkin and Rayleigh Ritz methods - Integration by parts – Basics of variational formulation – Polynomial and Nodal approximation.

**UNIT II  ONE DIMENSIONAL ANALYSIS**  
Steps in FEM – Discretization. Interpolation, derivation of elements characteristic matrix, shape function, assembly and imposition of boundary conditions solution and post processing – One dimensional analysis in solid mechanics and heat transfer.

**UNIT III  SHAPE FUNCTIONS AND HIGHER ORDER FORMULATIONS**  
Shape functions for one and two dimensional elements- Three nodded triangular and four nodded quadrilateral element Global and natural co-ordinates—Nonlinear analysis – Isoparametric elements – Jacobian matrices and transformations – Basics of two dimensional, plane stress, plane strain and axisymmetric analysis.

**UNIT IV  COMPUTER IMPLEMENTATION**  
Pre Processing, mesh generation, elements connecting, boundary conditions, input of material and processing characteristics – Solution and post processing – Overview of application packages – Development of code for one dimensional analysis and validation

**UNIT V  ANALYSIS OF PRODUCTION PROCESSES**  
criteria – FE analysis of metal cutting, chip separation criteria, incorporation of strain rate dependency – FE analysis of welding.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are highly confident in
(1) Fundamentals of Finite Element Methods.
(2) Perform one dimensional and Two-dimensional analysis using FEA
(3) Perform finite element formulations to solve problems
(4) perform finite element analyses and evaluate the results of a select set of manufacturing processes,
(5) Provide simulations through FE Software

REFERENCES:
7. www.pollockeng.com
8. www.tbook.com

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></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Avg.</td>
<td>1.66</td>
<td></td>
<td>3</td>
<td>2.66</td>
<td>2</td>
<td>1.5</td>
</tr>
</tbody>
</table>

MF4004 MATERIALS MANAGEMENT

OBJECTIVES:
To introduce the students
(1) the various concepts of materials management
(2) familiarize them with vendor development and rating
(3) the various aspects of Logistics and storage
(4) Planning and Forecasting of the need
(5) Various aspects of Inventory management

UNIT I INTRODUCTION
Introduction to materials management – Objectives – Functions – Operating Cycle – Value analysis – Make or buy decisions.

UNIT II  MANAGEMENT OF PURCHASE

UNIT III  MANAGEMENT OF STORES AND LOGISTICS

UNIT IV  MATERIALS PLANNING

UNIT V  INVENTORY MANAGEMENT
ABC analysis – Aggregate planning – Lot size under constraints – Just in Time (JIT) system.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are
(1) Familiarized with the various concepts and functions of material management
(2) Able to handle the purchase and stores Independently
(3) Understand Logistics and inventory pricing
(4) Materials planning and periodic replenishment of material
(5) Just in time techniques and inventory management

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

CO-PO Mapping
OBJECTIVES:
(1) To introduce the concepts of Ergonomics and to indicate the areas of Applications.
(2) Identify ergonomic principles
(3) to increase awareness of the need and role of ergonomics in occupational health
(4) To inculcate analysing skills among the students with respect to work place design, working postures and lifting tasks.
(5) To provide thorough knowledge about assessment about occupational exposure to heat stress, noise, vibrations

UNIT I INTRODUCTION

UNIT II ANTHROPOMETRY
Physical dimensions of the human body as a working machine – Motion size relationships – Static and dynamic anthropometry – Anthropometric aids – Design principles – Using anthropometric measures for industrial design – Procedure for anthropometric design.

UNIT III DESIGN OF SYSTEMS

UNIT IV ENVIRONMENTAL FACTORS IN DESIGN

UNIT V WORK PHYSIOLOGY
Provision of energy for muscular work – Role of oxygen physical exertion – Measurement of energy expenditure Respiration – Pulse rate and blood pressure during physical work – Physical work capacity and its evaluation.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are
(1) updated with various concepts of Ergonomics
(2) able to provide appropriate allowances for the jobs under analysis.
(3) Students will be able to analyse and calculate the level of risk in a job causing stress, fatigue and musculoskeletal disorders and design appropriate work systems.
(4) Students will be able to assess the occupational environmental factors like heat stress, noise, and vibration and RSPM level in the industry.
(5) Maintain a comfortable environment in the work place

REFERENCES:

**CO-PO Mapping**

<table>
<thead>
<tr>
<th>CO</th>
<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>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Avg.</td>
<td>1.33</td>
<td>-</td>
<td>1.66</td>
<td>2.66</td>
<td>2</td>
<td>1.5</td>
<td>-</td>
</tr>
</tbody>
</table>

MF4006 POLYMERS AND COMPOSITE MATERIALS L T P C 3 0 0 3

**OBJECTIVES:**

1. To impart knowledge on various polymer processing techniques
2. To learn about various fibre, Matrix materials and their properties
3. To learn the methods by which Polymer matrix composites are made
4. To study about the composites used for High temperature applications
5. To study the behaviour of reinforcements in MMC and PMC

**UNIT I PROCESSING OF POLYMERS**


**UNIT II FIBERS AND MATRIX MATERIALS**


**UNIT III PROCESSING OF POLYMER MATRIX COMPOSITES**


**UNIT IV PROCESSING OF METAL MATRIX COMPOSITES**


**UNIT V PROCESSING OF CERAMIC MATRIX COMPOSITES AND**
CARBON-CARBON COMPOSITES

Processing of CMCs: cold pressing, sintering, reaction bonding, liquid infiltration, lanxide process – in situ chemical reaction techniques: chemical vapour deposition, chemical vapour impregnation, sol-gel – interfaces in CMCs – mechanical properties and applications of CMCs – Carbon-carbon Composites – applications.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are expected

- To study matrix material, reinforcements of polymer matrix composites, MMC and ceramic matrix composites.
- To develop knowledge on processing, interfacial properties and application of composites.
- To have ability to develop new fibre or reinforcement materials
- To differentiate between the composites used in room temperature and High temperature applications

REFERENCES:

CO-PO Mapping

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

MF4092 NON-DESTRUCTIVE TESTING 3 0 0 3

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  9
Principles, Instrumentation for ECT, Absolute, differential probes, Techniques – High sensitivity techniques, Multi frequency, Phased array ECT, Applications.
Principle of AET, Instrumentation, Applications - testing of metal pressure vessels, Fatigue crack detection in aerospace structures.

UNIT III  MAGNETIC PARTICLE TESTING & THERMOGRAPHY  9
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  9
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  9
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

TOTAL:  45 PERIODS

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

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></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
OBJECTIVE:
(1) To implement lean manufacturing concepts in the factories.
(2) Understand the distinction between mass and lean production and to be able to assess the difference in a manufacturing environment.
(3) Understand the various elements of Lean systems.
(4) Learn the importance of JIT.
(5) Understand the various Inspection systems and effectively plan for a Lean system.

UNIT I INTRODUCTION:
The mass production system – Origin of lean production system – Necessity – Lean revolution in Toyota – Systems and systems thinking – Basic image of lean production – Customer focus – Muda (waste).

UNIT II STABILITY OF LEAN SYSTEM:
Standards in the lean system – 5S system – Total Productive Maintenance – standardized work – Elements of standardized work – Charts to define standardized work – Man power reduction – Overall efficiency - standardized work and Kaizen – Common layouts.

UNIT III JUST IN TIME

UNIT IV JIDOKA (AUTOMATION WITH A HUMAN TOUCH)

UNIT V WORKER INVOLVEMENT AND SYSTEMATIC PLANNING METHODOLOGY
Involvement – Activities to support involvement – Quality circle activity – Kaizen training - Suggestion Programmes – Hoshin Planning System (systematic planning methodology) – Phases of Hoshin Planning – Lean culture.

OUTCOMES:
The student will be competent
(1) To know the necessity for a Lean Manufacturing system
(2) To Differentiate between the conventional Mass production system with Lean system
(3) In effectively implement the principles of JIT.
(4) To apply the Inspection tools effectively in the Lean systems
(5) To apply Hoshin planning system to create a Lean culture in Industry.

REFERENCES

### 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>1</td>
<td>3</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Avg.</td>
<td>1</td>
<td>1.5</td>
<td>3</td>
<td>2</td>
<td>1.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

### OBJECTIVES:

(1) To impart knowledge about different types of robots and configuration
(2) To gain fundamental knowledge on robot manipulators.
(3) To provide a brief knowledge on geometry, kinematics, dynamics, motion planning and control
(4) To impart knowledge in Robot designing and programming
(5) To familiarize with sensors and actuators used in robots

### UNIT I

**INTRODUCTION**
Definition, Need Application, Types of robots – Classifications – Configuration, work volume, control loops, controls and intelligence, specifications of robot, degrees of freedoms, end effectors – types, selection applications.

### UNIT II

**ROBOT KINEMATICS**

### UNIT III

**ROBOT DYNAMICS AND TRAJECTORY PLANNING**
Lagrangeon mechanics, dynamic equations for sing, double and multiple DOF robots – static force analysis of robots, Trajectory planning – joint space, Cartesian space description and trajectory planning – third order, fifth order - Polynomial trajectory planning, Machine Vision
UNIT IV  ROBOT PROGRAMMING & AI TECHNIQUES  9
Types of Programming – Teach Pendant programming – Basic concepts in A1 techniques – Concept of knowledge representations – Expert system and its components.

UNIT V  ROBOT SENSORS AND ACTUATORS  9
Design of Robots – characteristics of actuating systems, comparison, microprocessors control of electric motors, magnetostrictive actuators, shape memory type metals, sensors, position, velocity, force, temperature, pressure sensors – Contact and non-contact sensors, infrared sensors, RCC, vision sensors.

OUTCOMES:
At the end of this course the students are expected
(1) Classify and configure robots
(2) Apply the kinematic arrangement of robots and its applications in the area of manufacturing sectors
(3) To select sensors for different application
(4) To build a robot for any type of application
(5) To develop and Expert system

REFERENCES:

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>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Avg</td>
<td>1</td>
<td>2.33</td>
<td>2.33</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

MF4009  MEMS AND NANOTECHNOLOGY  L T P C
3 0 0 3

OBJECTIVES:
(1) To inspire the students to expect to the trends in manufacturing of micro components
(2) Familiarise the students with various fabrication techniques for micro components.
(3) Acquaint them with various sensors and actuators
(4) Introduce them the various methods of developing nano materials
(5) Make them understand characterization tools

UNIT I  OVER VIEW OF MEMS AND MICROSYSTEMS  9
Definition – historical development – properties, design and fabrication micro-system, microelectronics, working principle, applications and advantages of micro system. Substrates and wafers, silicon as substrate material, mechanical properties of Si, Silicon Compounds - silicon piezo resistors, Gallium arsenide, quartz, polymers for MEMS, conductive polymers.

UNIT II  FABRICATION PROCESSES AND MICRO SYSTEM PACKAGING  9

UNIT III  
MICRO DEVICES


UNIT IV  
SCIENCE AND SYNTHESIS OF NANO MATERIALS


UNIT V  
CHARACTERIZATION OF NANO MATERIALS


OUTCOMES:
At the end of this course the students are expected
(1) Realise the need of micro electromechanical systems.
(2) Develop a knowledge to select a sensor for an application
(3) Develop a nano material
(4) characterize the Nano material
(5) Develop an Electromechanical systems

TOTAL: 45 PERIODS

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>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Units</td>
<td>Credits</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>---------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V</td>
<td>9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL: 45 PERIODS**

**CM4091  GREEN MANUFACTURING**

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

**COURSE OBJECTIVES**

1. To expose the students to the basics of environmental sustainability and impact assessment objectives.
2. To incorporate knowledge about the environmental based improvements towards lean manufacturing systems.
3. To analyze various machineries with intent to conserve energy.
4. To analyze hazardous and solid wastes with intent to point out areas of adverse environmental impact and how this impact could be minimized or prevented.
5. To impart the knowledge about the need, procedure and benefits of Green-Co rating.

**UNIT – I  ENVIRONMENTAL SUSTAINABILITY AND IMPACT ASSESSMENT**

Environmental impact assessment objectives – Legislative development – European community directive – Hungarian directive. Strategic environmental assessment and sustainability appraisal. Regional spatial planning and environmental policy.

**UNIT – II  LEAN MANUFACTURING AND GREEN ENERGY SYSTEM**


**UNIT – III  ENERGY SAVING MACHINERY AND COMPONENTS**


**UNIT – IV  HAZARDOUS AND SOLID WASTE MANAGEMENT**


**UNIT – V  GREEN CO-RATING**

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: Understand the Concepts of environmental sustainability and environmental impact assessment objectives
CO2: Apply suitable schemes towards design of green manufacturing requirements.
CO3: Analyze manufacturing processes towards conservation of energy.
CO4: Analyze manufacturing processes towards minimization or prevention of hazardous and solid wastes.
CO5: Acquire Knowledge of green co-rating and its benefits are well known to the students.

CO-PO MAPPING:

<table>
<thead>
<tr>
<th>Course Outcomes</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>1</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>AVG.</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

REFERENCES:
4. World Commission on Environment and Development (WCED), Our Common Future, Oxford

MF4010 COMPUTER AIDED PRODUCT DESIGN

OBJECTIVES:
(1) To Learn the basic concepts of Designing and Drafting.
(2) To Learn the computer aided modelling and various concepts of product design.
(3) Integrating CAE, CAD, CAM tools in product design and assess the quality and performance of products.
(4) To learn reliability and Maintainability concepts.
(5) To learn the failure analysis tools for improvement

UNIT I INTRODUCTION
Introduction to Engineering Design – Various phases of systematic design – sequential engineering and concurrent engineering – Computer hardware & Peripherals – software packages for design and drafting.

UNIT II COMPUTER GRAPHICS FUNDAMENTALS AND GEOMETRIC MODEL


UNIT III PRODUCT DESIGN CONCEPTS AND PRODUCT DATA MANAGEMENT


UNIT IV PRODUCT DESIGN TOOLS & TECHNIQUES


UNIT V PRODUCT DESIGN TECHNIQUES


TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are expected
(1) To model a product using CAD software.
(2) Assess the data for the need for a new product
(3) To apply the various design concepts and design tools and techniques while designing a product.
(4) To know the challenges in the product development
(5) To apply the failure analysis in the product design

REFERENCES:

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></td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>Avg.</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2.25</td>
<td>2</td>
<td>1.33</td>
</tr>
</tbody>
</table>
MF4011 PROCESS PLANNING AND COST ESTIMATION

OBJECTIVES:
(1) To introduce the process planning concepts and its necessity
(2) Economical planning of tools and equipment requirement
(3) Differentiate between cost accounting and cost estimation
(4) Cost Estimation and analysis
(4) To estimate time for various machining operations

UNIT I INTRODUCTION TO PROCESS PLANNING
Introduction- methods of process planning-Drawing Interpretation-Material evaluation – steps in process selection, Production equipment and tooling selection

UNIT II PROCESS PLANNING ACTIVITIES
Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods – Set of documents for process planning-Economics of process planning- case studies

UNIT III INTRODUCTION TO COST ESTIMATION

UNIT IV PRODUCTION COST ESTIMATION
Estimation of Different Types of Jobs – Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

UNIT V MACHINING TIME CALCULATION
Estimation of Machining Time – Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring – Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding

TOTAL: 45 PERIODS
OUTCOMES:
(1) Explain the concept of selection and steps in process planning, tooling, equipment selection and material evaluation
(2) Calculate process parameters and select Jig, Fixtures and quality assurance methods
(3) Apply the methods of costing and to explain the concept of estimation.
(4) Compute the cost of the product in various shops of production.
(5) Calculate the machining time for various operation

REFERENCES:

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>2</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>3</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Avg.</td>
<td>1.66</td>
<td>1</td>
<td>2.33</td>
<td>2.66</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

MF4091 MANUFACTURING MANAGEMENT

OBJECTIVES
1. Students will be able to study the concepts in facility planning.
2. Students will be able to study types of plant layout and capacity planning methods.
3. Students will be able to study the concepts of Project management.
4. Students will be able to study the concepts and methods in production planning and control.
5. Students will be able to study the concepts in Inventory and maintenance management.

UNIT-I FACILITY PLANNING
Facility planning – Factors affecting selection of plant location, Factor rating analysis: Break – even analysis, Load distance model, closeness ratings – case study

UNIT-II CAPACITY & LAYOUT PLANNING
Types of plant layout, criteria for good layout, Process layout, Assembly line balancing. Computer based solutions to layout problems such as CRAFT, ALDEP, CORELAP and PREP. Capacity planning – Analysis of designed capacity, installed capacity, commissioned capacity, utilized capacity, factors affecting productivity and capacity expansion strategies.

UNIT-III PROJECT MANAGEMENT
Demand forecasting – Quantitative and qualitative techniques, measurement of forecasting errors, Project management – its role in functional areas of management, network representation of a project, CPM and PERT techniques – case study

UNIT-IV PRODUCTION PLANNING & CONTROL
Aggregate production planning, production planning strategies, Disaggregating the aggregate plan, Materials Requirement Planning (MRP), MRP-II, Supply chain management, Operation scheduling, prioritization.

UNIT-V INVENTORY AND MAINTENANCE MANAGEMENT
Introduction to EOQ models, Inventory control techniques – ABC, FSN, VED etc. Types of inventory control – Perpetual, two-bin and periodic inventory system – JIT, SMED, Kanban, Zero inventory, Maintenance strategies and planning, Maintenance economics: quantitative analysis, optimal number of machines, Replacement strategies and policies – economic service life, opportunity cost, replacement analysis using specific time period.

TOTAL =45 PERIODS

COURSE OUTCOMES:
On Completion of the course the student will be able to
1. Able to acquire knowledge on facility, and problems associated with it.
2. Ability to learn the various capacity and layout planning models
3. Understand the concepts of demand forecasting and project management with relevant case studies.
4. Able to understand the concepts of production planning and scheduling.
5. Understand the various inventory and maintenance management techniques.

<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>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg</td>
<td>(10/5)=2</td>
<td>(5/5)=1</td>
<td></td>
<td>(3/3)=1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

PROGRESS THROUGH KNOWLEDGE
REFERENCES:

MF4012  NANOTECHNOLOGY  3 0 0 3

OBJECTIVES:
The course is aimed to
(1) Offer an overview on properties of Nanomaterials in their design and fabrication.
(2) Inculcate insight of the nano defects and doping effects of Nanomaterials in their design fabrication.
(3) Educate them on various nano structuring processes and recent trends
(4) Provide them with knowledge of nanostructure classification and various synthetic approaches.
(5) Make them understand various Nanomaterial characterization techniques

UNIT I  OVER VIEW OF NANOTECHNOLOGY
definition – historical development – properties, design and fabrication Nanosystems, working principle, applications and advantages of nano system. Nanomaterials – ordered oxides – Nano arrays – potential health effects

UNIT II  NANODEFECTS, NANO PARTICLES AND NANOLAYERS

UNIT III  NANOSTRUCTURING
UNIT IV  SCIENCE AND SYNTHESIS OF NANO MATERIALS
Classification of nano structures – Effects of nano scale dimensions on various properties – structural, thermal, chemical, magnetic, optical and electronic properties fluid dynamics – Effect of nano scale dimensions on mechanical properties - vibration, bending, fracture

UNIT V  CHARACTERIZATION OF NANO MATERIALS

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are expected
(1) Obtain the knowledge on Nano systems and its applications.
(2) Gain the fundamentals of nano defects and properties.
(3) Acquire knowledge about nano structuring and fabrication techniques
(4) Apply the concepts and techniques to design various nanomaterial-based devices
(5) Aware of various morphological techniques and selecting appropriate tools for their future research.

REFERENCES:


## CO-PO Mapping

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</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>1.2</td>
</tr>
</tbody>
</table>

---

**MF4013 MATERIALS TESTING AND CHARACTERIZATION TECHNIQUES**  
**L T P C**  
**3 0 0 3**

**OBJECTIVE:**

1. Make them acquainted with microscopic techniques to analyse crystal structures
2. Acquire an understanding on the electron microscopic techniques for characterization
3. Gain a fundamental on chemical and thermal analysis
4. Provide the knowledge on various static methods to characterize materials
5. Study the failure of materials under stress

**UNIT I MICRO AND CRYSTAL STRUCTURE ANALYSIS**  

**UNIT II ELECTRON MICROSCOPY**  

**UNIT III CHEMICAL AND THERMAL ANALYSIS**  

**UNIT IV MECHANICAL TESTING – STATIC TESTS**  

**UNIT V MECHANICAL TESTING – DYNAMIC TESTS**

TOTAL: 45 PERIODS

OUTCOMES:
1) At the end of this course the students are expected
2) to be knowledgeable in microstructure evaluation, crystal structure analysis,
3) to take images in electron microscopy and process those images,
4) to do Chemical Thermal Analysis,
5) Analyse the results of static and dynamic mechanical testing.

REFERENCES:

CO-PO Mapping

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

<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>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Avg.</td>
<td>1</td>
<td>1.66</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1.66</td>
</tr>
</tbody>
</table>
OBJECTIVES:
(1) Understand key elements of Mechatronics system, representation into block diagram
(2) It gives the frame work of knowledge that allows engineers and technicians to develop an interdisciplinary understanding and integrated approach to engineering.
(3) Understand principles of sensors, its characteristics, interfacing with DAQ microcontroller
(4) Understand the concept of PLC system and its ladder programming, and significance of PLC systems in industrial application
(5) Understand the PLC used in home appliances

UNIT I  INTRODUCTION

UNIT II  SENSORS AND TRANSDUCERS

UNIT III  MICROPROCESSORS AND MICROCONTROLLERS
Introduction – Architectures of 8 – bit microcontrollers (8051) series, PIC Microcontrollers (16f xxx) series – Assembly language programming instruction format, addressing modes, instruction sets, Basic program examples interface of keypads, LEDs, A/D and D/A Converters, RS 232 serial communication interface, classification of memories.

UNIT IV  ACTUATORS

UNIT V  MECHATRONIC SYSTEMS
Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies – Engine management system, Automatic camera, Automatic wishing machine, Pick and place robots.

TOTAL: 45 PERIODS
OUTCOMES:
The student will be able to
(1) Identify the key elements of mechatronics system and its representation in terms of block diagram.
(2) Understand the concept of signal processing and use of interfacing systems such as ADC, DAC, digital I/O
(3) Interfacing of Sensors, Actuators using appropriate DAQ micro-controller
(4) Differentiate between traditional design and Mechatronics design
(5) Apply the mechatronics concepts in home appliances

REFERENCES:

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>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Avg.</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>1.75</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

MR4071 INTERNET OF THINGS FOR MANUFACTURING

COURSE OBJECTIVES:
1. To understand the basics of IoT, Opportunities and challenges in IoT
2. To design a IoT solution
3. To develop an IoT prototype
4. To explain the various protocols used in IoT and Localization
5. To examine the applications of IoT in Manufacturing

UNIT I INTRODUCTION
UNIT II  DESIGN OF IoT  9
Design challenges in IoT - Standardization, Security and privacy, Infrastructure, Analytics. Design steps for implementing IoT.

UNIT III  PROTOTYPING OF IoT  9

UNIT IV  PREREQUISITES FOR IoT  9
IOT Technologies Wireless protocols low-power design (Bluetooth Low Energy), range extension techniques (data mining and mesh networking), and data-intensive IoT for continuous recognition applications Data storage and analysis Localization algorithms Localization for mobile systems

UNIT V  APPLICATION IN MANUFACTURING  9
Applications HCI and IoT world - Multilingual interactions Robotics and Autonomous Vehicles Sensing and data processing - Simultaneous mapping and localization - Levels of autonomy, Smart factories, Future research challenges

TOTAL : 45 PERIODS

COURSE OUTCOME:
On completion of the course, the students will be able to
CO1: Identify the Opportunities and challenges in IoT
CO2: Propose a suitable IoT design
CO3: Develop an optimized IoT prototype
CO4: Understand the various protocols used in IoT and Localization
CO5: Understand the applications of IoT in Manufacturing

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></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Avg</td>
<td>(5/5)=1</td>
<td>(10/5)=2</td>
<td>(1/1)=1</td>
<td></td>
<td>(12/4)=3</td>
<td></td>
</tr>
</tbody>
</table>

IS4071  DATA ANALYTICS  L  T  P  C
COURSE OBJECTIVES:
1. Recognize the importance of data analytics
2. Exhibit competence on data analytics packages
3. Apply solution methodologies for industrial problems.

UNIT I  INTRODUCTION

UNIT II  MULTIPLE REGRESSION
Multiple Regression- Linear and Nonlinear techniques- Backward-Forward-Stepwise Hierarchical regression-Testing interactions (2way interaction) - Analysis of Variance and Covariance (ANOVA & ANCOVA) - Multivariate Analysis of Variance and Covariance (MANOVA & MANCOVA).

UNIT III  LOGISTIC REGRESSION
Regression with binary dependent variable -Simple Discriminant Analysis Multiple Discriminant analysis-Assessing classification accuracy- Conjoint analysis (Full profile method).

UNIT IV  PRINCIPAL COMPONENT ANALYSIS
Principal Component Analysis -Factor Analysis- Orthogonal and Oblique Rotation-Factor Score Estimation-Multidimensional Scaling-Perceptual Map-Cluster Analysis (Hierarchical Vs Nonhierarchical Clustering).

UNIT V  LATENT VARIABLE MODELS
Latent Variable Models an Introduction to Factor, Path, and Structural Equation Analysis- Time series data analysis (ARIMA model) – Decision tree analysis (CHAID, CART) - Introduction to Big Data Management.

COURSE OUTCOMES:
On completion of the course, the student will be able to:
- To recognize the importance of data analytics
- To Exhibit competence on data analytics packages
- To apply solution methodologies for industrial problems.

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

CM4071 MANUFACTURING SYSTEM SIMULATION

OBJECTIVES:
• To discuss the importance and advantages of applying simulation and modelling techniques
• To teach various random number generation techniques, its use in simulation
• To explain the applications of random probability distributions in real time environments.
• To train students to solve discrete event problems using software.
• To train students on Simulation models using a simulation software.

UNIT I INTRODUCTION
Systems and its types, Types of Modelling, Principles used in Modeling, simulation as a decision making tool, types of simulation, Advantages and disadvantages of simulation, Steps in simulation model building - statistical models in simulation - discrete and continuous system

UNIT II RANDOM NUMBERS

UNIT III RANDOM VARIATES

UNIT IV ANALYSIS OF SIMULATION DATA
Input modelling-Fitness tests – verification and validation of simulation models – output analysis for a single model, Comparison and evaluation of alternate system design, Optimization using simulation.

UNIT V SIMULATION LANGUAGES AND CASE STUDIES
Simulation languages and packages- Case studies in WITNESS; FLEXSIM, ARENA, SIMQUICK- Simulation based optimization- Modelling and Simulation with Petrinets - Case studies in manufacturing and material handling system- Monte Carlo Simulation. Simulation of Single Server Queuing System. Simulation of manufacturing shop Simulation of Inventory System

TOTAL: 45 PERIODS

OUTCOMES
CO1: Explain the Manufacturing Models of Discrete event systems
CO2: Develop the Uncertainty using Random numbers and Random Variates
CO3: Analyze the verification & valediction of Models and Optimization
CO4: Demonstrate the concepts of modeling layers of society's critical infrastructure networks
CO5: Make use of tools to view and control simulations

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>1</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PD4391**

PRODUCT LIFECYCLE MANAGEMENT

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

**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  9
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  9
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></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>2</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Avg</td>
<td>1.4</td>
</tr>
</tbody>
</table>

REFERENCES
OBJECTIVE:
(1) Learn to know the necessity for a New Product by analysing the market trend
(2) Select methodology and process for development
(3) Generate detailed specifications for the given architecture
(4) Integrating CAE, CAD, CAM tools in product design and assess the quality and performance of products
(5) Make a prototype of a problem adhering to design principles to enhance manufacturability

UNIT I PRODUCT DEVELOPMENT AND CONCEPT SELECTION

UNIT II PRODUCT ARCHITECTURE
Product architecture – Implication of the architecture – Establishing the architecture – Related system level design issues.

UNIT III INDUSTRIAL AND MANUFACTURING DESIGN
Need for industrial design – Impact of industrial design – Industrial design process. Assessing the quality of industrial design- Human Engineering consideration - Estimate the manufacturing cost – Reduce the component cost – Reduce the assembly cost – Reduce the support cost – Impact of DFM decisions on other factors

UNIT IV PROTOTYPING AND ECONOMIC ANALYSIS
Principles of prototyping – Planning for prototypes - Elements of economic analysis – Base case financial model – Sensitivity analysis – Influence of the quantitative factors

UNIT V MANAGING PRODUCT DEVELOPMENT PROJECTS
Sequential, parallel and coupled tasks - Baseline project planning – Project Budget Project execution – Project evaluation- patents- patent search-patent laws International code for patents.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are expected to
(1) Identify the need for a New Product
(2) design and develop various products
(3) Work out the cost of developing a product
(4) Will be able to prototype the product
(5) Know how to patent the new design or the product
REFERENCES:

CO-PO Mapping

<table>
<thead>
<tr>
<th></th>
<th>CO</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td>1.25</td>
<td>-</td>
<td>3</td>
<td>2.25</td>
<td>1.75</td>
<td>1.2</td>
</tr>
</tbody>
</table>

MF4016  ENTREPRENEURSHIP DEVELOPMENT  L T P C 3 0 0 3

OBJECTIVE:
(1) To develop and strengthen entrepreneurial quality and motivation in students.
(2) To impart knowledge on the competencies necessary to establish new ventures
(3) To inculcate strategic thinking, budgeting and ethical behaviour which are vital to enhance entrepreneurial skills
(4) To establish start-ups and small businesses
(5) To evaluate the business and monitor

UNIT I  ENTREPRENEURAL COMPETENCE

UNIT II  ENTREPRENEURAL ENVIRONMENT

UNIT III  BUSINESS PLAN PREPARATION

UNIT IV  LAUNCHING OF SMALL BUSINESS

UNIT V  MANAGEMENT OF SMALL BUSINESS
Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units - Effective Management of small Business.

TOTAL: 45 PERIODS

COURSE OUTCOME:
Students will
(1) Gain knowledge and skills needed to run a business.
(2) Innovate and solve challenges in business
(3) Determine risks in the trade and respond effectively
(4) Utilize tools and develop strategies to manage business
(5) Establish start-ups and Evaluate the business

REFERENCES:

**CO-PO Mapping**

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Avg.</td>
<td></td>
<td>1</td>
<td>1</td>
<td>2.5</td>
<td>1.75</td>
<td>1.66</td>
<td>2</td>
</tr>
</tbody>
</table>

**MF4020**
**INDUSTRIAL SAFETY**

**OBJECTIVES:**
(1) To develop and strengthen the safety ideas and motivate the students to impart basic safety skills
(2) To know about Industrial safety programs, Industrial laws, regulations and source models
(3) To understand about fire and explosion, preventive methods, relief and its sizing methods
(4) To assess the safety of human beings from toxic substances
(5) To analyse industrial hazards and its risk assessment.

**UNIT I**
**OPERATIONAL SAFETY**

UNIT II SAFETY APPRAISAL AND ANALYSIS 9

UNIT III OCCUPATIONAL HEALTH 9
Concept and spectrum of health functional units and activities of operational health service – occupational and related disease – levels of prevention of diseases – notifiable occupational diseases Toxicology Lead – Nickel, chromium and manganese toxicity – gas poisoning (such as CO, Ammonia Chlorise, So2, H2s.) their effects and prevention – effects of ultra violet radiation and infrared radiation on human system.

UNIT IV SAFETY AND HEALTH REGULATIONS 9

UNIT V SAFETY MANAGEMENT 9

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are
1. Expected to gain knowledge and skills needed to run an industry with utmost safety precautions.
2. Understand the industrial laws, regulations and source models.
3. Apply the methods of prevention of fire and explosions.
4. Analyse the effect of release of toxic substances
5. Understand the methods of hazard identification and preventive measures.

REFERENCES:

CO-PO Mapping
COURSE OBJECTIVES

1. Understand major types of special steels such as HSLA, TRIP, Dual and Tool steels and cast-irons
2. To study the polymer behaviour and develop polymer composites
3. To study energy conversion materials
4. To learn about various materials used for bio implants
5. To understand the advantage of materials at Nano scale

UNIT I METALLIC MATERIALS
Classification of metallic materials - Ferrous and nonferrous.
Ferrous metals and alloys - Introduction to specifications – types of steels, alloy steels, tool steels; stainless steels, HSLA, TRIP steels, TWIP steels. Shape memory alloys – Intermetallic – Superalloys - Titanium and Magnesium alloys – Bulk metallic glass –high entropy alloys- metamaterials –topological materials

UNIT II POLYMERS AND COMPOSITES
Structure of polymers, characterization and applications of polymers: mechanical behavior of polymers, strengthening of polymers, crystallization and glass transition phenomenon and types of polymers.
Composites: Particle reinforced composites, fiber reinforced composites – influence of fiber length, orientation and concentration. Fiber phase, matrix phase, metal matrix composites, polymer matrix composites, ceramic matrix composites, carbon – carbon composites, hybrid composites and structural composites.

UNIT III ENERGY MATERIALS
Need for high performance energy materials - carbon nanostructure based energy conversion and storage materials - nanomaterials for solar cell applications - next generation energy storage materials – Li and Ni based batteries, fuel cells.

UNIT IV BIO MATERIALS
Introduction to biomaterials; need for biomaterials; Salient properties of important material classes; Property requirement of biomaterials; Metallic implant materials, ceramic implant materials, polymeric implant materials, composites as biomaterials; Orthopedic, dental and other applications.
Biomaterials preparation and characterization; Processing and properties of different bio ceramic materials; Mechanical and physical properties evaluation of biomaterials; New and novel materials for biomedical applications. Design concept of developing new materials for bio-implant applications; Nanomaterials and nanocomposites for medical applications

UNIT V NANO MATERIALS 9
Concept of nano materials – scale / dimensional aspects, Top-down and bottom-up approaches for preparing nano materials Advantages and limitations at the nano level – thermodynamic aspects at the nano level, health and environmental issues.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students would be able to:
(1) Understand the various ferrous alloys and their applications
(2) Understand different types of composite materials and polymers
(3) Understand Solar materials
(4) Understand the properties of different biomaterials
(5) Understand the structure and behavior of Nano materials

REFERENCES

CO-PO Mapping

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

MF4018 ARTIFICIAL INTELLIGENCE L T P C
3 0 0 3

OBJECTIVES:
The objective of this course is to enable the students to
(1) Understand the basic concepts of intelligent agents
(2) Develop general-purpose problem-solving agents, logical reasoning agents, and agents that reason under uncertainty
(3) To learn to represent knowledge in solving AI problems
(4) To understand the different ways of designing software agents
(5) Employ AI techniques to solve some of today’s real-world problems.

UNIT I INTELLIGENT AGENTS
Introduction to AI – Agents and Environments – Concept of rationality – Nature of environments
– Structure of agents Problem solving agents – search algorithms – uninformed search strategies

UNIT II PROBLEM SOLVING
Heuristic search strategies – heuristic functions Local search and optimization problems – local search in
continuous space – search with non-deterministic actions – search in partially observable environments
– online search agents and unknown environments

UNIT III GAME PLAYING AND CSP
Game theory – optimal decisions in games – alpha-beta search – monte-carlo tree search – stochastic
games – partially observable games Constraint satisfaction problems – constraint propagation –
backtracking search for CSP – local search for CSP – structure of CSP

UNIT IV LOGICAL AGENTS
Knowledge-based agents – propositional logic – propositional theorem proving – propositional model
checking – agents based on propositional logic First-order logic – syntax and semantics – knowledge
representation and engineering – inferences in first-order logic – forward chaining – backward chaining –
resolution

UNIT V KNOWLEDGE REPRESENTATION AND PLANNING
Ontological engineering – categories and objects – events – mental objects and modal logic – reasoning
systems for categories – reasoning with default information Classical planning – algorithms for classical
planning – heuristics for planning – hierarchical planning – non deterministic domains – time, schedule,
and resources – analysis

COURSE OUTCOMES:
On successful completion of this course, the students will be able to
1. Explain autonomous agents that make effective decisions in fully informed, partially
   observable, and adversarial settings
2. Choose appropriate algorithms for solving given AI problems
3. Design and implement logical reasoning agents
4. Design and implement agents that can reason under uncertainty
5. Apply AI for real world problems

TEXT BOOKS:
   2009.
2. I. Bratko, —Prolog: Programming for Artificial Intelligencell, Fourth edition, Addison-Wesley

REFERENCES
1. M. Tim Jones, —Artificial Intelligence: A Systems Approach (Computer Science) II, Jones and

<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></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Avg</td>
<td>1</td>
<td></td>
<td>2</td>
<td>2.66</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

CO-PO Mapping

**MF4019**

**SMART MANUFACTURING**

**L T P C**

3 0 0 3

**COURSE OBJECTIVES**

(1) To introduce students to fundamentals of Manufacturing
(2) To familiarize with selection of sensors for various application
(3) To learn the basics of agent-based manufacturing
(4) Understand Cyber physical systems
(5) Provide brief understanding about industry 4.0 concepts in Manufacturing systems

**UNIT I**

**SENSORS SMART MANUFACTURING**


**UNIT II**

**DATA ANALYTICS**

Introduction to Data and Analytics in a Digital Context (Internet of Things), Product Data Management for Design and Manufacturing (PLM Tools), Typical data challenges (data quality, enrichment, integration of ERP & PLM data), Preparing data for analytics (techniques to improve data quality, integration - ETL)

Advances in data visualization & related tools-Statistical Techniques for Analytics, Descriptive Statistics Inferential statistics, Regression and ANOVA

**UNIT II**

**CYBER PHYSICAL SYSTEMS**

Concept of Cyber Physical Systems (CPS) and Cyber Physical Production System (CPPS), System Architecture for implementation of CPPS, Components for CPPS, Communication for CPPS

**UNIT IV**

**E- MANUFACTURING**

UNIT V      INDUSTRY 4.0
Evaluation of industries, Introduction to Industry 4.0, Challenges in industry 4.0, Impact of Industry 4.0, Case studies on industry 4.0, Introduction to Internet of Things (IoT) and its applications, Smart supply chain and Case studies.

TOTAL :45 PERIODS

COURSE OUTCOMES
The students are expected to appreciate:
(1) Appreciate concepts and basic framework necessary for smart manufacturing
(2) current trends at system level in manufacturing organizations
(3) Use of Sensors and Selection of sensors for various applications
(4) IoT based manufacturing systems
(5) The importance of industry 4.0 concepts at manufacturing systems

TEXT BOOKS:

Reference books:

CO-PO Mapping

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Avg</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>2.5</td>
<td>2</td>
<td>2</td>
<td>-</td>
</tr>
</tbody>
</table>

67
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
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II PRESENTATION SKILLS 6

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

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

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

TOTAL: 30 PERIODS

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

AX4092 DISASTER MANAGEMENT L T P C
2 0 0 0

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
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

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

AX4093 CONSTITUTION OF INDIA L T P C
2 0 0 0

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.
UNIT I

1. தமிழின் துவக்க நூல் ததொல்கொப்பியம் – எழுத்து, தொல், தபொருள்
2. அகநொனூறு (82)
   - இயற்கை ஆர்கியகம் அரங்கம்
3. குறிஞ்சிப் பொட்டின் மலர்க்கொட்சி
4. புறநொனூறு (95,195)
   - பபொகர் மின்கிழ கல்லூர்

UNIT II

1. அத்தநிலை மக்கள் கிளம்ப்பியறும்
   - ஆறு கீழ்புறுகள், ஆன்பனைசம், பூஜைதெய்வங்கள், சது, புகு
2. பிற ஆர்கியகம் – இமேசியம் மாற்றம்
   - தொன்றி, மும்பைத் தொன்றிகள், முதிர்கி, ஆண்டுக்கிட்டே
     (க்கத்தூர் முருந்தவியல் துடு)

UNIT III

1. காந்தணிகியின் புரட்சி
   - சிறுப்பதிகொரியக சுருக்கம்
   - சிறுப்பதிகொரியக மூக்கேயல்

UNIT IV

1. சிறுபோணைப்பகட பொரி
   - பரி முக்கியக் கொரியக, முக்கியக் கொரியக
   - பரியாரங்க கொரியக, தொன்றிகள்
   - சிறுப்பதிகொரியக முனைமுக்கியக
2. குறிசெய்து
   - அயருக்கார்களின் புந்தகம் கிளம்ப
3. சிறுபோணைப்பர் (617, 618)
61. தர்ம கல்வி விளையாட்டு

1. தமிழ் தந்தைகள் வள்ளலொர்
   - விலைச் செல்வு முறை
   - மூட்டணி முறை
   - மூட்டணி விளையாட்டு, கல்வி விளையாட்டு
   - பாடல் பிரித்துவா
   - தொடகத்து
2. தர்மபுர்த்திரவியல் வள்ளலொர்
3. சிறுக்கட்டு இலக்கியம், பயண இலக்கியம், நொடகம்
4. தபணு விளையாட்டும் விளையாட்டு மூட்டணிகளின் வேள்விப்பு
5. அறிவியல் களஞ்சியம்
6. இகணயத்தில் தமிழ்
7. சுற்றுசூழல் பம்பொட்டில் தமிழ் இலக்கியம்

TOTAL: 30 PERIODS

தமிழ் தொடர் திசைப்பிள் / புதுக்கலங்கள்

1. தமிழ் தொடர் தொழிலாய கல்விச் சேவை (Tamil Virtual University) - www.tamilvu.org
2. தமிழ் விக்கிப்பீடியா (Tamil Wikipedia) - https://ta.wikipedia.org
3. தமிழ் பல்கலைக் கழகம் (Tamil Virtual University) - www.tamilvu.org
4. தமிழ் விக்கிப்பீடியா (Tamil Wikipedia) - https://ta.wikipedia.org
5. தமிழ் விளையாட்டு கல்விச் சேவை - தமிழ் பல்கலைக் கழகம், thamilvalarchithurai.com
6. தமிழ் விளையாட்டு கல்விச் சேவை - தமிழ் பல்கலைக் கழகம், thamilvalarchithurai.com

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>27.</td>
<td>OCE431</td>
<td>Integrated Water Resources Management</td>
<td>3 L 0 P</td>
<td>3</td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
<td>G</td>
<td>L</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------------------------</td>
<td>---------</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>OCE432</td>
<td>Water, Sanitation and Health</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>OCE433</td>
<td>Principles of Sustainable Development</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>OCE434</td>
<td>Environmental Impact Assessment</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>OIC431</td>
<td>Blockchain Technologies</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>OIC432</td>
<td>Deep Learning</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>OBA431</td>
<td>Sustainable Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>OBA432</td>
<td>Micro and Small Business Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>OBA433</td>
<td>Intellectual Property Rights</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>OBA434</td>
<td>Ethical Management</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>ET4251</td>
<td>IoT for Smart Systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>ET4072</td>
<td>Machine Learning and Deep Learning</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PX4012</td>
<td>Renewable Energy Technology</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PS4093</td>
<td>Smart Grid</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CP4391</td>
<td>Security Practices</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MP4251</td>
<td>Cloud Computing Technologies</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>IF4072</td>
<td>Design Thinking</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MU4153</td>
<td>Principles of Multimedia</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>DS4015</td>
<td>Big Data Analytics</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NC4201</td>
<td>Internet of Things and Cloud</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MX4073</td>
<td>Medical Robotics</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>VE4202</td>
<td>Embedded Automation</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CX4016</td>
<td>Environmental Sustainability</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TX4092</td>
<td>Textile Reinforced Composites</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>NT4002</td>
<td>Nanocomposite Materials</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>BY4016</td>
<td>IPR, Biosafety and Entrepreneurship</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
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

Water for food production: ‘blue’ versus ‘green’ water debate – Water foot print - Virtual water trade for achieving global water and food security — Irrigation efficiencies, irrigation methods - current water pricing policy– scope to relook pricing.

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 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:

**CO – PO Mapping - INTEGRATED WATER RESOURCES MANAGEMENT**

<table>
<thead>
<tr>
<th>POs/PSOs</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</td>
<td>Knowledge of Engineering Sciences</td>
<td>3</td>
</tr>
<tr>
<td>PO2</td>
<td>Problem analysis</td>
<td>1</td>
</tr>
<tr>
<td>PO3</td>
<td>Design / development of solutions</td>
<td>2</td>
</tr>
<tr>
<td>PO4</td>
<td>Investigation</td>
<td>1</td>
</tr>
<tr>
<td>PO5</td>
<td>Modern Tool Usage</td>
<td>1</td>
</tr>
<tr>
<td>PO6</td>
<td>Individual and Team work</td>
<td>2</td>
</tr>
<tr>
<td>PO7</td>
<td>Communication</td>
<td>2</td>
</tr>
<tr>
<td>PO8</td>
<td>Engineer and Society</td>
<td>2</td>
</tr>
<tr>
<td>PO9</td>
<td>Ethics</td>
<td>2</td>
</tr>
<tr>
<td>PO10</td>
<td>Environment and Sustainability</td>
<td>3</td>
</tr>
<tr>
<td>PO11</td>
<td>Project Management and Finance</td>
<td>1</td>
</tr>
<tr>
<td>PO12</td>
<td>Life Long Learning</td>
<td>2</td>
</tr>
<tr>
<td>PSO1</td>
<td>Knowledge of field research methodology, gender, legal and environmental aspects in the context of integrated water resources management</td>
<td>3</td>
</tr>
<tr>
<td>PSO2</td>
<td>Formulate, analyze and comprehend the differences in social and environmental variability in South Indian context with their peers and strive to work towards sustainability</td>
<td>2</td>
</tr>
<tr>
<td>PSO3</td>
<td>Produce and publish professional reports, peer-reviewed journal, on contemporary and state of the art research in integrated water resources management</td>
<td>2</td>
</tr>
</tbody>
</table>
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

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


UNIT III CHALLENGES IN MANAGEMENT AND DEVELOPMENT


UNIT IV GOVERNANCE

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.

OUTCOMES:

| CO1 | Capture to fundamental concepts and terms which are to be applied and understood through the study. |
| CO2 | Comprehend the various factors affecting water sanitation and health through the lens of the 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. |

TOTAL: 45 PERIODS
REFERENCES

CO PO MAPPING : WATER, SANITATION AND HEALTH

<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>CO</td>
<td>CO2</td>
</tr>
<tr>
<td>PO1 Knowledge of Engineering Sciences</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO2 Problem analysis</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO3 Design / development of solutions</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>PO4 Investigation</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PO5 Modern Tool Usage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO6 Individual and Team work</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO7 Communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO8 Engineer and Society</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO9 Ethics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PO10 Environment and Sustainability</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO11 Project Management and Finance</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>PO12 Life Long Learning</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PSO1 Explain the concepts of water management, field research methodology, gender, legal and environmental aspects in the context of integrated water resources management</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PSO2 Formulate, analyse and comprehend the differences in social and economic variability in South Asian context with their peers and strive to work towards sustainability.</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>PSO3 Produce and publish professional reports, peer reviewed journal on contemporary and state of art research in water resources Engineering.</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
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 FRAMEWORK

UNIT III SUSTAINABLE DEVELOPMENT AND WELLBEING

UNIT IV SUSTAINABLE SOCIO-ECONOMIC SYSTEMS

UNIT V ASSESSING PROGRESS AND WAY FORWARD
OUTCOMES:
- On completion of the course, the student is expected to be able to

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

REFERENCES:

CO – PO Mapping – Principles of Sustainable Development

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>Course Outcome</th>
<th>Overall Correlation of COs to POs</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1 Knowledge of Engineering Science</td>
<td>CO1 3  3  3  3  3</td>
<td>3</td>
</tr>
<tr>
<td>PO2 Problem analysis</td>
<td>CO2 3  3  3  3  3</td>
<td></td>
</tr>
<tr>
<td>PO3 Design / development of solutions</td>
<td>CO3 3  3  3  3  3</td>
<td></td>
</tr>
<tr>
<td>PO4 Investigation</td>
<td>CO4 3  3  3  3  3</td>
<td></td>
</tr>
<tr>
<td>PO5 Modern Tool Usage</td>
<td>CO5 3  3  3  3  3</td>
<td></td>
</tr>
<tr>
<td>PO6 Individual and Team work</td>
<td>PO7 Communication 1  1  1  1  1</td>
<td></td>
</tr>
<tr>
<td>PO8 Engineer and Society</td>
<td>PO9 Ethics 2  2  2  2  2</td>
<td></td>
</tr>
<tr>
<td>PO10 Environment and Sustainability</td>
<td>PO11 Project Management and Finance 3  3  3  3  3</td>
<td></td>
</tr>
<tr>
<td>PO12 Life Long Learning</td>
<td>PO13 Knowledge of Environmental Management discipline 3  3  3  3  3</td>
<td></td>
</tr>
<tr>
<td>PSO1 Environmental Performance Evaluation and coordination</td>
<td>PSO2 3  3  3  3  3</td>
<td></td>
</tr>
</tbody>
</table>

TOTAL: 45 PERIODS
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

| CO1 | Understand need for environmental clearance, its legal procedure, need of EIA, types, stakeholders and their roles |
| CO2 | Understand various impact identification methodologies, prediction techniques a model of impacts on various environments |
| CO3 | Understand relationship between social impacts and change in community due development activities and rehabilitation methods |
| CO4 | Document the EIA findings and prepare environmental management and monitori plan |
| CO5 | Identify, predict and assess impacts of similar projects based on case studies |
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>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
<th>Overall Correlation of COs to Pos</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>Knowledge of Engineering Sciences</td>
<td>3</td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>PO2</td>
<td>Problem analysis</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>PO3</td>
<td>Design / development of solutions</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>PO4</td>
<td>Investigation</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>PO5</td>
<td>Modern Tool Usage</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>PO6</td>
<td>Individual and Team work</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>PO7</td>
<td>Communication</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>PO8</td>
<td>Engineer and Society</td>
<td>2</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>PO9</td>
<td>Ethics</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>PO10</td>
<td>Environment and Sustainability</td>
<td>3</td>
<td></td>
<td>2</td>
<td>2</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>PO11</td>
<td>Project Management and Finance</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>PO12</td>
<td>Life Long Learning</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>L</td>
</tr>
<tr>
<td>PSO1</td>
<td>Knowledge of Environmental Engineering discipline</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>PSO2</td>
<td>Environmental Performance Evaluation and coordination</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>PSO3</td>
<td>Conceptualization of Environmental Engineering Systems</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

OIC431 BLOCKCHAIN TECHNOLOGIES L T P C
3 0 0 3

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:

CO-PO Mapping

<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>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg</td>
<td>2.00</td>
<td>1.00</td>
<td>2.50</td>
<td>2.25</td>
<td>2.00</td>
<td>2.00</td>
</tr>
</tbody>
</table>
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

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 LT P C 3 0 0 3

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 9
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 9
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 9
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

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

UNIT II SCREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN
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
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
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
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>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>
</tr>
<tr>
<td>CO2</td>
<td>3</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>2</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

OBA433   INTELLECTUAL PROPERTY RIGHTS

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 9
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 9

UNIT IV STRATEGIES IN INTELLECTUAL PROPERTY 9
Strategies for investing in R&D, Patent Information and databases, IPR strength in India, Traditional Knowledge, Case studies.

UNIT V MODELS 9
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></td>
<td>2</td>
<td></td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>3</td>
<td>2</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

OBA434 ETHICAL MANAGEMENT L T P C 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
to leading your career and your company, 2016.

MAPPING OF POs AND COs

<table>
<thead>
<tr>
<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>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
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

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

TOTAL: 45 PERIODS
<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td><strong>Avg.</strong></td>
<td>1.75</td>
</tr>
</tbody>
</table>

**REFERENCES:**


**ET4072**

**MACHINE LEARNING AND DEEP LEARNING**

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

**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.

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td>Avg.</td>
<td>2.42</td>
</tr>
</tbody>
</table>
REFERENCES:

PX4012 RENEWABLE ENERGY TECHNOLOGY L T P C
3 0 0 3

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 renewat 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 systy classification- standalone PV systems - Grid tied and grid interactive inverters- grid connection issue

UNIT IV WIND ENERGY CONVERSION SYSTEMS
Origin of Winds: Global and Local Winds- Aerodynamics of Wind turbine-Derivation of Betz’s lirr Power available in wind-Classification of wind turbine: Horizontal Axis wind turbine and Vertical a: wind turbine- Aerodynamic Efficiency-Tip Speed-Tip Speed Ratio-Solidity-Blade Count-Power curve wind turbine - Configurations of wind energy conversion systems: Type A, Type B, Type C and Type Configurations- Grid connection Issues - Grid integrated SCIG and PMSG based WECS.

UNIT V OTHER RENEWABLE ENERGY SOURCES
Qualitative study of different renewable energy resources: ocean, Biomass, Hydrogen ener systems, Fuel cells, Ocean Thermal Energy Conversion (OTEC), Tidal and wave energy, Geotherm 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 po
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:
1. S.N.Bhadra, D. Kastha, & S. Banerjee “Wind Electrical Systems”, Oxford UniversityPre:
2009.

CO-PO MAPPING :

<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>CO1</td>
<td>3</td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td></td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td></td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td></td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td></td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

PS4093 SMART GRID L T P C
3 0 0 3

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.

TOTAL : 45 PERIODS

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>2</td>
<td>2</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>

AVG 2.25 2 1.66 2.25 2.3 2
CP4391 SECURITY PRACTICES L T P C 3 0 0 3

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 9

UNIT II NETWORK SECURITY 9

UNIT III SECURITY MANAGEMENT 9

UNIT IV CYBER SECURITY AND CLOUD SECURITY 9

UNIT V PRIVACY AND STORAGE SECURITY 9

TOTAL: 45 PERIODS

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

CO-PO Mapping

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

MP4251 CLOUD COMPUTING TECHNOLOGIES  

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

UNIT II CLOUD PLATFORM ARCHITECTURE

UNIT III AWS CLOUD PLATFORM - IAAS
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

UNIT V  PROGRAMMING MODEL
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

MU4153 PRINCIPLES OF MULTIMEDIA L T P C
3 0 0 3

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

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
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  

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:
DS4015 BIG DATA ANALYTICS

L T P C 3 0 0 3

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.

REFERENCE:

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

NC4201 INTERNET OF THINGS AND CLOUD L T P C

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  9
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  9

UNIT V  IoT AND CLOUD  9

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
3 0 0

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 sensor, Proximity sensors, force sensors, Pneumatic and hydraulic actuators, Stepper motor control circuit, 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 pneuma manipulator, Forward Kinematic Problems, Inverse Kinematic Problems, Solutions of Inver Kinematic problems

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

UNIT III  SURGICAL ROBOTS
Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgic 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 G Rehabilitation Robots, Motion Correlation and Tracking, Motion Prediction, Motion Replicatc 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 technoloç Sensors, Actuators, Portable Energy Storage, Human–robot cognitive interaction (cHRI), Human robot physical interaction (pHRI), Wearable Robotic Communication - case study

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
CO-PO Mapping

<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>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td></td>
<td>2</td>
<td>3</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td></td>
<td>2</td>
<td></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Avg</td>
<td>2</td>
<td>2</td>
<td>1.8</td>
<td>2.6</td>
<td>2.3</td>
<td></td>
</tr>
</tbody>
</table>

VE4202 EMBEDDED AUTOMATION LT P C 3 0 0 3

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
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
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
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

UNIT – V HOME AUTOMATION
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

TOTAL: 45 PERIODS
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:

CO-PO Mapping

<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></td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Avg</td>
<td>(5/5)=1</td>
<td>(12/4)=3</td>
<td>(5/5)=1</td>
<td>(5/5)=1</td>
<td>(5/5)=1</td>
<td>(12/4)=3</td>
</tr>
</tbody>
</table>

CX4016 ENVIRONMENTAL SUSTAINABILITY

UNIT I INTRODUCTION
Valuing the Environment: Concepts, Valuing the Environment: Methods, Property Rights, Externalities, and Environmental Problems

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

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

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

Development, Poverty, and the Environment, Visions of the Future, Environmental economics and policy by Tom Tietenberg, Environmental Economics

TOTAL: 45 PERIODS

REFERENCES

REFERENCES
NT4002  NANOCOMPOSITE MATERIALS  L T P C

UNIT I  BASICS OF NANOCOMPOSITES  9

UNIT II  METAL BASED NANOCOMPOSITES  9
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  9
Preparation and characterization of diblock Copolymer based nanocomposites; Polymer Carbon nanotubes based composites, their mechanical properties, and industrial possibilities.

UNIT IV  NANOCOMPOSITE FROM BIOMATERIALS  9
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  9

TOTAL : 45 PERIODS

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

UNIT I IPR

UNIT II AGREEMENTS, TREATIES AND PATENT FILING PROCEDURES

UNIT III BIOSAFETY

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

TOTAL : 45 PERIODS
REFERENCES