PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):
I. To create a high qualified mechatronics engineer, who have ability to design, develop and analyze the mechatronic system and provide optimal solutions with basic and advanced technology for industrial and societal problems.
II. To develop innovative and sustainable products with multidisciplinary expertise.
III. To develop a successful entrepreneur in their field with strong communication and high ethics.
IV. To develop industry readiness engineer with complex solving capability and lifelong learning.
V. To develop high employability in industry and academia.

PROGRAMME OUTCOMES (POs):

<table>
<thead>
<tr>
<th>PO</th>
<th>Programme Outcome</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.</td>
</tr>
<tr>
<td>4</td>
<td>Post Graduates able to acquaint the knowledge in key concepts, methods, core elements, design, modern tools and techniques for unified mechatronic systems and their intelligence.</td>
</tr>
<tr>
<td>5</td>
<td>Post Graduates will apply to develop the solution for various engineering system needs using a mechatronics-based approach.</td>
</tr>
<tr>
<td>6</td>
<td>Post Graduates able to build the real-time/virtual mechatronics system within realistic constraints such as industrial, economic, environmental, ethical, social, health and safety aspects.</td>
</tr>
</tbody>
</table>

PEO & PO Mapping

<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>I.</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>II.</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>III.</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>IV.</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>V.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>VI.</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>COURSE NAME</td>
<td>PO1</td>
<td>PO2</td>
<td>PO3</td>
<td>PO4</td>
<td>PO5</td>
<td>PO6</td>
</tr>
<tr>
<td>----------------------------------------------------------</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
</tr>
<tr>
<td>Applied Mathematics for Mechatronics Engineers</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Concepts in Electronics Engineering</td>
<td>1.8</td>
<td>-</td>
<td>2.4</td>
<td>2</td>
<td>1.8</td>
<td>2.2</td>
</tr>
<tr>
<td>Concepts of Machines and Mechanisms</td>
<td>1.8</td>
<td>-</td>
<td>2.4</td>
<td>2</td>
<td>1.8</td>
<td>2.2</td>
</tr>
<tr>
<td>Sensors and Actuators</td>
<td>2.2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Control System Design</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Industrial Automation</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Research Methodology and IPR</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Professional Elective I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Audit Course I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensors and Actuators Laboratory</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1.3</td>
</tr>
<tr>
<td>Industrial Automation Laboratory</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1.3</td>
</tr>
<tr>
<td>Mechatronics System Design</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Industrial Robotics and Control</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Machine Vision systems</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Intelligence in systems</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Smart Embedded Systems</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Professional Elective – II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Audit Course II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial Robotics and Embedded Systems Laboratory</td>
<td>-</td>
<td>1.3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Machine Vision and Intelligence Laboratory</td>
<td>-</td>
<td>1.3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Professional Elective - III</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professional Elective - IV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open Elective</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Work I</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Project Work II</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
### ANNA UNIVERSITY, CHENNAI

**NON-AUTONOMOUS COLLEGES AFFILIATED TO ANNA UNIVERSITY**

**M.E. MECHATRONICS**

**REGULATIONS – 2021**

**CHOICE BASED CREDIT SYSTEM**

**I TO IV SEMESTERS CURRICULA AND SYLLABI**

#### 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><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>MA4104</td>
<td>Applied Mathematics for Mechatronics</td>
<td>FC</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>MR4101</td>
<td>Concepts in Electronics Engineering</td>
<td>FC</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>MR4102</td>
<td>Concepts of Machines and Mechanisms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>MR4103</td>
<td>Sensors and Actuators</td>
<td>PCC</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>MR4104</td>
<td>Control System Design</td>
<td>PCC</td>
<td>3</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>MR4105</td>
<td>Industrial Automation</td>
<td>PCC</td>
<td>3</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</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>Professional Elective – I</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Audit Course -I</td>
<td>AC</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td><strong>PRACTICAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>MR4111</td>
<td>Sensors and Actuators Laboratory</td>
<td>PCC</td>
<td>0</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>MR4112</td>
<td>Industrial Automation Laboratory</td>
<td>PCC</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>21</strong></td>
<td><strong>32</strong></td>
<td><strong>25</strong></td>
</tr>
</tbody>
</table>

* Audit Course is optional
<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>THEORY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>MR4201</td>
<td>Mechatronics System Design</td>
<td>PCC</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>MR4202</td>
<td>Industrial Robotics and Control</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>MR4203</td>
<td>Machine Vision Systems</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>MR4204</td>
<td>Intelligence in Systems</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5.</td>
<td>MR4205</td>
<td>Smart Embedded Systems</td>
<td>PCC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Professional Elective – II</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td>Audit Course II*</td>
<td>AC</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PRACTICAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>MR4211</td>
<td>Industrial Robotics and Embedded Systems Laboratory</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>9.</td>
<td>MR4212</td>
<td>Machine Vision and Intelligence Laboratory</td>
<td>PCC</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TOTAL</td>
<td></td>
<td>21</td>
<td>0</td>
<td>8</td>
</tr>
</tbody>
</table>

* Audit Course is optional

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>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>THEORY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td>Professional Elective - III</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>Professional Elective - IV</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>Open Elective</td>
<td>OEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PRACTICAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>MR4311</td>
<td>Project Work - I</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TOTAL</td>
<td></td>
<td>9</td>
<td>0</td>
<td>12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>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>PRACTICAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>MR4411</td>
<td>Project Work-II</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TOTAL</td>
<td></td>
<td>0</td>
<td>0</td>
<td>24</td>
</tr>
</tbody>
</table>

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 75
## FOUNDATION COURSES (FC)

<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></td>
<td></td>
<td>Lecture</td>
<td>Tutorial</td>
<td>Practical</td>
</tr>
<tr>
<td>1.</td>
<td>MA4104</td>
<td>Applied Mathematics for Mechatronics</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>MR4101</td>
<td>Concepts in Electronics Engineering</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>MR4102</td>
<td>Concepts of Machines and Mechanisms</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

## PROFESSIONAL CORE COURSES (PCC)

<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></td>
<td></td>
<td>Lecture</td>
<td>Tutorial</td>
<td>Practical</td>
</tr>
<tr>
<td>1.</td>
<td>MR4103</td>
<td>Sensors and Actuators</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>MR4104</td>
<td>Control System Design</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>MR4105</td>
<td>Industrial Automation</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>MR4111</td>
<td>Sensors and Actuators Laboratory</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>5.</td>
<td>MR4112</td>
<td>Industrial Automation Laboratory</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>MR4201</td>
<td>Mechatronics System Design</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>MR4202</td>
<td>Industrial Robotics and Control</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8.</td>
<td>MR4203</td>
<td>Machine Vision Systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9.</td>
<td>MR4204</td>
<td>Intelligence in Systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10.</td>
<td>MR4205</td>
<td>Smart Embedded Systems</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11.</td>
<td>MR4211</td>
<td>Industrial Robotics and Embedded Systems Laboratory</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>12.</td>
<td>MR4212</td>
<td>Machine Vision and Intelligence Laboratory</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>
PROFESSIONAL ELECTIVES

SEMESTER I, ELECTIVE - I

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MR4001</td>
<td>Computer Aided Inspection</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>MR4002</td>
<td>Digital Manufacturing</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>MR4003</td>
<td>Computer Aided Production and Automation of Plants</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>MR4004</td>
<td>Design of Machine Elements and Product Development</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>MR4005</td>
<td>Multi-Body Dynamics</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>MR4006</td>
<td>Onboard Computers and Python Programming</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

SEMESTER II, ELECTIVE - II

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MR4007</td>
<td>Micro and Nano Systems</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>MR4008</td>
<td>Advanced Control Systems</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>MR4009</td>
<td>Biomechatronics</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>MR4010</td>
<td>Solid State Drives</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>MR4011</td>
<td>Automotive Electronics</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>MR4012</td>
<td>Unmanned Aerial Vehicle</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

SEMESTER III, ELECTIVE - III & IV

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>CONTACT PERIODS</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>MR4013</td>
<td>Intelligent Product Design</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>IL4073</td>
<td>Human Industrial Safety and Hygiene</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>MR4071</td>
<td>Internet of Things for Manufacturing</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>MR4014</td>
<td>Communication Protocols</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>MR4015</td>
<td>Advanced Computer Vision</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>MR4016</td>
<td>Mechatronics in Aero Systems</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>MR4017</td>
<td>Medical Mechatronics</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>MR4018</td>
<td>Mobile Robotics</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>CM4091</td>
<td>Green Manufacturing</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>MR4019</td>
<td>Haptics and Augmented Reality</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>MR4020</td>
<td>Industrial Instrumentation and Control</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>MR4021</td>
<td>Modeling and Analysis of Electromechanical Systems</td>
<td>PEC</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</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>1.</td>
<td>MR4311</td>
<td>Project Work - I</td>
<td>0 0 12</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>MR4411</td>
<td>Project Work-II</td>
<td>0 0 24</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL CREDITS</strong></td>
<td></td>
<td><strong>18</strong></td>
<td></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>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL CREDITS</strong></td>
<td></td>
<td><strong>2</strong></td>
<td></td>
</tr>
</tbody>
</table>

### AUDIT COURSES (AC)

Registration for any of these courses is optional to students

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>AX4091</td>
<td>English for Research Paper Writing</td>
<td>2 0 0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>AX4092</td>
<td>Disaster Management</td>
<td>2 0 0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>AX4093</td>
<td>Constitution of India</td>
<td>2 0 0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>AX4094</td>
<td>கைவியாசம் இலக்கியம்</td>
<td>2 0 0</td>
<td>0</td>
</tr>
</tbody>
</table>
# LIST OF OPEN ELECTIVES FOR PG PROGRAMMES

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>OCE431</td>
<td>Integrated Water Resources Management</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>OCE432</td>
<td>Water, Sanitation and Health</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>OCE433</td>
<td>Principles of Sustainable Development</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>OCE434</td>
<td>Environmental Impact Assessment</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>OIC431</td>
<td>Blockchain Technologies</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>OIC432</td>
<td>Deep Learning</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td>OBA431</td>
<td>Sustainable Management</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td>OBA432</td>
<td>Micro and Small Business Management</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>9.</td>
<td>OBA433</td>
<td>Intellectual Property Rights</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>10.</td>
<td>OBA434</td>
<td>Ethical Management</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>11.</td>
<td>ET4251</td>
<td>IoT for Smart Systems</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>12.</td>
<td>ET4072</td>
<td>Machine Learning and Deep Learning</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>13.</td>
<td>PX4012</td>
<td>Renewable Energy Technology</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>14.</td>
<td>PS4093</td>
<td>Smart Grid</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>15.</td>
<td>CP4391</td>
<td>Security Practices</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>16.</td>
<td>MP4251</td>
<td>Cloud Computing Technologies</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>17.</td>
<td>IF4072</td>
<td>Design Thinking</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>18.</td>
<td>MU4153</td>
<td>Principles of Multimedia</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>19.</td>
<td>DS4015</td>
<td>Big Data Analytics</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>20.</td>
<td>NC4201</td>
<td>Internet of Things and Cloud</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>21.</td>
<td>MX4073</td>
<td>Medical Robotics</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>22.</td>
<td>VE4202</td>
<td>Embedded Automation</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>23.</td>
<td>CX4016</td>
<td>Environmental Sustainability</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>24.</td>
<td>TX4092</td>
<td>Textile Reinforced Composites</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>25.</td>
<td>NT4002</td>
<td>Nanocomposite Materials</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>26.</td>
<td>BY4016</td>
<td>IPR, Biosafety and Entrepreneurship</td>
<td>3 0 0</td>
<td>3</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:
1. Mathematical foundations of numerical techniques for solving linear systems, eigenvalue problems and generalized inverse.
2. To expose the students to variational formulation and numerical integration techniques and demonstrate solution methodology for the variational problems.
3. To understand the basics of random variables with emphasis on the standard discrete and continuous distributions.
4. To make the students appreciate the purpose of using Laplace transforms to solve the partial differential equation.
5. To introduce the Fourier transforms and its properties.

UNIT – I  MATRIX THEORY  

UNIT – II  CALCULUS OF VARIATIONS  

UNIT – III  PROBABILITY AND RANDOM VARIABLES  

UNIT – IV  LAPLACE TRANSFORM TECHNIQUES FOR PDE  

UNIT – V  FOURIER TRANSFORM TECHNIQUES FOR PDE  

COURSE OUTCOMES:
At the end of the course, students will be able to
1. apply various methods in matrix theory to solve system of linear equations.
2. maximizing and minimizing the functional that occur in various branches of Engineering disciplines.
3. computation of probability and moments, standard distributions of discrete and continuous random variables and functions of a random variable.
4. application of Laplace transforms to initial value, initial- boundary value and boundary value problems in Partial Differential Equations.
5. obtain Fourier transforms for the functions which are needed for solving application problems.
REFERENCES:

MR4101 CONCEPTS IN ELECTRONICS ENGINEERING L T P C 2 0 2 3

COURSE OBJECTIVES
1. To understand the functionality of fundamental electronic components.
2. To understand the functions of the operational amplifier and its applications.
3. To review and use the logic gates for various digital circuit development.
4. To understand the functions and uses in measurement.
5. To learn the power management of various electronic units.

UNIT I ELECTRONIC COMPONENTS AND DEVICES 6
Resistors, capacitors, inductors, transformers – types and properties - junction diodes, Zener diodes, transistors and thyristors - types-operating mechanism-characteristics and applications. LED – characteristics and applications

UNIT II OPERATIONAL AMPLIFIERS AND APPLICATIONS 6
Operational amplifiers – principles, specifications, characteristics and applications- arithmetic operations, integrator, differentiator, comparator, Schmitt trigger, instrumentation amplifiers, active filters, linear rectifiers, waveform generators, A/D converters, feedback and power amplifiers, sine wave oscillators

UNIT III DIGITAL ELECTRONICS 6

UNIT IV SIGNAL PROCESSING AND MEASURING DEVICES 6
UNIT V  POWER MANAGEMENT
Pulse width modulation and pulse position modulation – batteries–SMPS - sensors, actuators and controllers’ energy consumption -power optimization of integrated system.

TOTAL: 30 PERIODS

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

CO1: Apply the fundamental electronic components in various circuits.
CO2: Create the basic electronic circuits using op-amp for various applications.
CO3: Create the digital electronic circuits using logic gate ICs’.
CO4: Apply the power supply and measurement system appropriately for various applications.
CO5: Measure, estimate and monitor the power for various applications to use battery or electrical power sources.

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>2</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>AVG.</td>
<td>1.8</td>
<td>-</td>
<td>2.4</td>
<td>2</td>
<td>1.8</td>
<td>2.2</td>
</tr>
</tbody>
</table>

REFERENCES

LABORATORY

LIST OF EXPERIMENTS
2. Experimentation with CRO.
3. Design of DC power supplies
4. Design of inverting amplifier and non-inverting amplifiers
5. Design of Instrumentation amplifier.
7. Design of combinational circuits and sequential circuits.
9. RC Servo motor driver circuit.
10. Design of stepper motor driver circuit.

TOTAL: 30 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:
1. CRO-1
2. DSO-1
3. DC Power supply
   5V – 5 No’s
12V, 10A - 1 No
24V, 10A or higher - 1 No
4. Function generator-1
5. OP-Amp trainer kit (inverting and non-inverting amplifier module)
6. Analog filters trainer kit
7. Sequential circuit trainer kit
8. Combination circuit trainer kit
9. A/D Converter trainer kit -1 No
10. D/A Converter Trainer kit-1 No
11. Driver Circuit Module for servomotor-1 No
12. Driver Circuit module for stepper motor-1 No
13. Multi-Meter, bread board, and solder machine.
14. Electronic components for power supply (transformer, regulator, diode, capacitors) -5 No’s.

MR4102 CONCEPTS OF MACHINES AND MECHANISMS

COURSE OBJECTIVES
1. To understand the functionality of basic mechanisms and to determine the position, velocity, and acceleration profiles of these mechanisms.
2. To recognize the effect of friction in joints and to know the various types of mechanical power transmission using belt drives.
3. To identify the nomenclature of gear and to understand the functions and typical uses of various types of gears and Cams.
4. To understand the behaviors of the vibration in various machines.
   To make use of various conventional machine tools for component development.

UNIT I MECHANISMS

UNIT II FRICTION
Types of friction - friction in screw and nuts - pivot and collar - thrust bearings - collar bearing - plate and disc clutches - belt (flat & vee) and rope drives - creep in belts - Jockey pulley - open and crossed belt drives - Ratio of tensions - Effect of centrifugal and initial tension - condition for maximum power transmission.

UNIT III GEARING AND CAMS
Gear profile and geometry-nomenclature of spur and helical gears - law of gearing - interference requirement of minimum number of teeth in gears-gear trains-simple and compound gear trains determination of speed and torque in epicyclic gear trains-Cam profile-different types of followers.

UNIT IV VIBRATION
Free, forced and damped vibrations of single degree of freedom systems - force transmitted to supports - vibration Isolation - vibration absorption - torsional vibration of shafts - single and multirotor systems - geared shafts - critical speed of shafts.
UNIT V  MACHINE TOOLS


TOTAL : 30 PERIODS

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

CO1: Apply the fundamental mechanism in machinery development.
CO2: Consider the functions of friction in joints and select of appropriate belt drives for the typical applications.
CO3: Select and use of appropriate gears and cams for system development.
CO4: Evaluate the possibility of vibration generation in the system design.
CO5: Demonstrate the various conventional machine tools and CNC Machines.

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>2</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>AVG.</td>
<td>1.8</td>
<td>-</td>
<td>2.4</td>
<td>2</td>
<td>1.8</td>
<td>2.2</td>
</tr>
</tbody>
</table>

REFERENCES

LABORATORY

LIST OF EXPERIMENTS
1. 2D modeling and 3D modeling of Bearing, and Couplings.
2. 2D modeling and 3D modeling of Gears and Ball screw.
3. 2D modeling and 3D modeling of Sheet metal components
4. 2D modeling and 3D modeling of Jigs, fixtures and Die.
5. 2D modeling and 3D modeling of Structures and frames
6. Modeling and simulation of mechanism of 4 Bar chain
8. Modeling and simulation of mechanism of Ball and screw and Rack and pinion.
10. Modeling and simulation of mechanism of Quick return and elliptical trammel.

TOTAL: 30 PERIODS

LIST OF SOFTWARES
Solid Works/ OpenCAD /CREO /CATIA/ NX CAD/MSC-Adams – 15 No’s
COURSE OBJECTIVES
1. To learn the various types of sensors, transducers, sensor output signal types, calibration techniques, formulation of system equation and its characteristics.
2. To understand basic working principle, construction, Application and characteristics of motion, proximity and ranging sensors.
3. To understand and analyse the working principle, construction, application and characteristics of force, magnetic and heading sensors.
4. To learn and analyse the working principle, construction, application and characteristics of optical, pressure, temperature and other sensors.

UNIT I INTRODUCTION TO SENSORS

UNIT II MOTION, OPTICAL AND RANGING SENSORS

UNIT III FORCE, MAGNETIC, AND HEADING SENSORS

UNIT IV FLUID POWER ACTUATORS

UNIT V ELECTRICAL DRIVES AND ACTUATORS

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Understand various sensor effects, sensor characteristics, signal types, calibration methods and obtain transfer function and empirical relation of sensors. They can also analyse the sensor response.
2. Analyze and select suitable sensor for motion, proximity and range measurement.
3. Analyze and select suitable sensor for force, magnetic field, speed, position and direction measurement.
4. Analyze and Select suitable sensor for light detection, pressure and temperature measurement and also familiar with other miniaturized smart sensors.
5. Understand the working principles of various actuators and their applications.

REFERENCES

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>3</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>AVG.</td>
<td>2.2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

MR4104 CONTROL SYSTEM DESIGN

COURSE OBJECTIVES
1. To represent and simplify the mathematical models for various types of physical systems.
2. To recognize the time domain specifications and to analyze of various types of system and its characteristics in time domain.
3. To know the frequency domain specifications and to analyze of various types of system and its characteristics in frequency domain methods.
4. To design compensator and controller using time and frequency domain.
5. To evaluate, analyse and design a control system of servomotors for motion control.
UNIT I  SYSTEM REPRESENTATION AND MODELLING  9
Introduction and need for Control Systems with examples – Feedback systems – Block Diagram –
Definition of Process variable, Set-point, Manipulated variable and Final control element with
examples -Open loop and Closed loop systems – Transfer Function Model – State Space Model –
Mathematical Modelling of Mechanical, Electrical, Pneumatic and Hydraulic systems – Block
Diagram reduction – Signal flow graph.

UNIT II  DESIGN OF FEEDBACK CONTROL SYSTEM  9
Feedback systems – Block Diagram – Definition of process variable, set –point, manipulated
variable and final control element with examples – characteristics of on –off,P, PI, PD and PID
controllers – Implementation issues of PID controller – Modified PID controller – Tuning of
controller.

UNIT III  TIME AND FREQUENCY DOMAIN ANALYSIS  9
Time response of First & Second order systems – Time domain specifications - steady state errors
and error constants – Routh Hurwitz criterion – Root locus – Bode Plot – Polar Plot – Nyquist
stability criterion – Stability analysis – Experimental determination of Transfer Functions

UNIT IV  CONTROL SYSTEM DESIGN  9
Root locus approach to control system design – lead, lag, lag-lead compensation using time domain
analysis. Control system design using frequency domain analysis - lead, lag, lag-lead compensation
using frequency domain analysis– P, PI, and PID controllers – tuning methods and rule.

UNIT V  CONTROL AND ANALYSIS OF SERVO MOTOR  9
Servo motor – Mathematical Modelling of Servo Motor – Analysis of Servo motor system using
Routh Hurwitz criterion, Root locus, Bode Plot, Polar Plot and stability analysis – Implementation of
P, PI , PD and PID controllers for servo motor and analysis - bumpless control transfer between
manual and PID Control- anti-windup control using PID Controller.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: Develop the mathematical model of physical systems.
CO2: Characterize the responses and evaluate the range of stability for the physical systems
using time domain techniques.
CO3: Describe and assess the range of stability for the physical systems using frequency
domain technique.
CO4: Design an appropriate control system and compensator for system dynamics.
CO5: Evaluate and demonstrate the motion control of motors.
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>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>AVG.</td>
<td>1</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

REFERENCES

LABORATORY

LIST OF EXPERIMENTS
2. Simulation and Reduction of Cascade and Parallel, and Closed Loop Sub-System.
3. Plot the pole-zero configuration in s-plane for the given Transfer Function.
4. Simulation and Analysis of First and Second Order System Equations in Time and frequency Domain
5. Simulation and Analysis of Root-Locus and Bode Plot.
7. Simulation of Motor velocity, position and torque control.

TOTAL: 30 PERIODS

LIST OF SOFTWARE FOR A BATCH OF 30 STUDENTS:
1. MATLAB/ SCILAB – Control System Tool Box - 15 No’s
COURSE OBJECTIVES

1. To understand the importance of automation in industry and various industrial standard sensors and process parameters to control the production process.
2. To learn PLC hardware, and practice the PLC programming and simulation in real systems.
3. To get knowledge on industrial standard data communication protocols, SCADA, centralized and decentralized control.
4. To get introduced to factory layout, Total Integrated Automation on factory and Industry 4.0.
5. To get exposure on building automation using sensors, controllers and actuators.

UNIT I INDUSTRIAL INSTRUMENTATION AND CONTROL
Introduction and need for automation-Instrumentation system for measurement of process parameters – overview on flow, level, pressure, temperature, speed, current and voltage measurements – proximity and vision based inspection systems – process control systems – continuous and batch process – feedback control system overview.

UNIT II PROGRAMMABLE LOGIC CONTROLLER

UNIT III DATA COMMUNICATION AND SUPERVISORY CONTROL SYSTEMS

UNIT IV FACTORY AUTOMATION
Factory layout - Tools and software based factory modeling -case study on automated manufacturing units, assembly unit, inspection systems and PLC based automated systems- Introduction to factory automation monitoring software

UNIT V BUILDING AUTOMATION

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the need of process parameter measurement and control.

CO2: Select, configure and program the PLC by interfacing the sensors and actuators and other input and output devices for automation.

CO3: Understand and compare various data communication protocols. Able to compare centralized, decentralized and smart control system.

CO4: Select and apply suitable sensor, control and actuation for factory automation. Also, they can simulate the same using software.
CO5: Select appropriate sensor, controller and actuation

CO-PO MAPPING:

<table>
<thead>
<tr>
<th>Course Outcomes</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>CO1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>AVG.</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

REFERENCES
UNIT V  PATENTS


REFERENCES

MR4111  SENSORS AND ACTUATORS LABORATORY

COURSE OBJECTIVES
1. To learn about various force, pressure and vibration measuring sensors.
2. To learn about various Temperature, light and magnetic field measuring sensors
3. To learn about various displacement and speed measuring sensors.

LIST OF EXPERIMENTS
SENSORS AND TRANSDUCERS
2. Determine the characteristics of Pressure Sensor and Piezoelectric Force Sensor
3. Displacement Measurement using LVDT.
4. Determine the Characteristics of Various Temperature Sensors.
5. Determine the Characteristics of Various Light Detectors (Optical Sensors).
7. Determine angular velocity using gyroscope, Vibration measurement using Accelerometer and Direction measurement using Magnetometer.

ACTUATORS
1. Experiments on control of Speed and Direction Control of DC Motor
2. Experiments on control of Position, Speed and Direction Control of Stepper Motor.
3. Experiments on control of Position, Speed and Direction Control of AC Servo Motors.
4. Experiment on control of Position, Speed and Direction Control of DC Servo Motors.

COURSE OUTCOMES:
Upon the completion of this course, the students will be able to;
1. Understand and demonstrate various contact and non-contact sensors.
2. Analyze and Identify appropriate sensors for given applications.
3. Create a sensor system for given requirements.
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>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>AVG.</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1.3</td>
</tr>
</tbody>
</table>

MR4112 INDUSTRIAL AUTOMATION LABORATORY

COURSE OBJECTIVES
1. To learn the basic operations in PLC.
2. To learn to integrate various sensors and actuators to PLC.
3. To apply the PLC controller to various systems through real-time applications.

LIST OF EXPERIMENTS
1. Experiments on Ladder Logic Program for Various Logic Gates AND, OR, NOT, NOR, NAND, EX-OR and EX-NOR.
2. Implement Various Mathematical Functions in PLC Using Ladder Diagram Programming Language.
3. Develop Ladder Diagram Programming to set Timer and Counter in PLC.
4. Experiments on Sensor and Actuator Interfacing and PLC to PLC Communication.
5. Experimental Verification of Speed Control Circuits in Pneumatic and Hydraulic Trainer.
6. Experimental Verification of Single and Double Acting Cylinder Circuits Using Different Directional Control Values.
7. Experimental Verification of Pneumatic Sequencing Circuits.
8. Experiments on Control of PLC Based Electro Pneumatic Sequencing Circuits.
10. Develop PLC Program to Maintain the Pressure and Level in a Bottle Filling System.
11. Develop Ladder Diagram Program in PLC For Material Filling and Object Shorting.
12. Develop the Ladder Diagram Program in PLC for Material Handling, Delaying Conveyor, Pick and Place Operation.

Note: Any of the 10 experiments to be conducted

TOTAL: 30 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:
- PLC Software -2 Users
- PLC Station with Communication Protocol, Sensors and Actuators – 2 No’s
- Electro Pneumatic Sequencing -1 Unit
- Electro Hydraulic Sequencing Circuits – 1 Unit
- PLC station with Pressure and Level in a Bottle Filling System – 1 Unit
- PLC station with Material Handling, Delaying Conveyor, Pick and Place Operation – 1 Unit.
COURSE OUTCOMES:
Upon completing this course Students able to
1. Understand and demonstrate PLC controller programming.
2. Analyse and Identify appropriate sensors and its integration with PLC for given applications.
3. Create a PLC controller system for given requirements

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>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>AVG.</td>
<td>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1.3</td>
</tr>
</tbody>
</table>

MR4201 MECHATRONICS SYSTEM DESIGN L T P C

12

UNIT I ELEMENTS OF MECHATRONICS

UNIT II MODELLING & SYSTEM IDENTIFICATION
UNIT III SIMULATION 12

UNIT IV DESIGN OPTIMIZATION 12

UNIT V CASE STUDIES ON MODELING OF MECHATRONIC SYSTEMS 12

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon Completion of the course, the students will be able to

CO1. Understand the list of elements required integrate the entire mechatronic systems developments.

CO2. Create the system dynamics of hybrid systems and to trial the system identification techniques and to practice the design, integration and simulation in virtual systems that are closer to the real time systems’ functionalities and its parameters.


CO4. Apply the optimization concepts mechatronics elements selection and process parameter optimization.

CO5. Integrate and analyze the mechatronics system design virtually and able to fine tune the system design and control algorithms in the software-in-loops before real time development.

REFERENCES:

CO-PO MAPPING:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>PO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PO1</td>
</tr>
<tr>
<td>CO1</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
</tr>
<tr>
<td>AVG.</td>
<td>2</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:
1. To know the basic terminologies, classification, configurations and components of serial manipulator.
2. To understand the mechanical design and robot arm kinematics
3. To learn and understand the various linear control techniques on manipulators
4. To learn and understand the various non-linear control techniques on manipulators
5. To learn the robot programming and demonstrate the robot in various applications

UNIT I  INTRODUCTION

UNIT II  ROBOT ARM 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

UNIT IV  NONLINEAR CONTROL OF MANIPULATORS
Introduction - nonlinear and time - varying systems - multi-input, multi-output control systems - the control problem for manipulators - practical considerations - current industrial-robot control systems - Lyapunov stability analysis – Cartesian - based control systems - adaptive control

UNIT V  ROBOT PROGRAMMING AND APPLICATIONS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon Completion of the course, the students will be able to
CO1. Understand the basics of Industrial Robotics and Control.
CO2. Create the kinematic solutions for the serial manipulators
CO3. Analyze linear control of manipulators
CO4. Analyze non-linear control of manipulators
CO5. Create robotic program for specific applications.

REFERENCES:

<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>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>AVG.</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

MR4203 MACHINE VISION SYSTEMS

COURSE OBJECTIVES:
1. To understand the basics concepts of optics and machine vision systems.
2. To learn and understand the fundamentals of image processing
3. To impart knowledge on stereo vision and structure from motion.
4. To understand the design factors in machine vision system design.
5. To demonstrate the various applications of machine vision system.

UNIT I INTRODUCTION
Human vision – Machine vision and Computer vision – Benefits of machine vision – Block diagram and function of machine vision system implementation of industrial machine vision system – Physics of Light – Interactions of light – Refraction at a spherical surface – Thin Lens Equation

UNIT II IMAGE PROCESSING FUNDAMENTALS
UNIT III    COMPUTATIONAL STEREO AND MOTION    9

UNIT IV    SMART VISION SYSTEM DESIGN    9
Camera types– Field view– Resolution: camera sensor resolution, Spatial resolution, Measurement of accuracy, Calculation of resolution, Resolution for a Line Scan Camera - Choice of camera, Frame grabber and hardware platform– Pixel rate– Lens design - digital and smart cameras.

UNIT V    APPLICATIONS AND CASE STUDIES    9

COURSE OUTCOMES:
Upon Completion of the course, the students will be able to
CO1. Understand the difference between the vision systems and were able to remember the functions of vision system.
CO2. Understand various image processing techniques and develop algorithms.
CO3. Create the visual serving for mechatronics applications
CO4. Evaluate and select appropriate lighting source, lighting technique, lens, sensor and interfacing.
CO5. Apply various machine vision techniques in various engineering fields.

TOTAL: 45 PERIODS

REFERENCES:

CO-PO MAPPING:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>PO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>AVG.</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:
1. To understand the basic concepts of artificial intelligence available in systems.
2. To learn and understand the basic concepts of artificial neural networks
3. To impart knowledge genetic algorithm.
4. To understand the components and concepts in fuzzy systems
5. To demonstrate the various applications of Artificial intelligence in systems

UNIT I INTRODUCTION 9
Approaches to intelligent control. Architecture for intelligent control. Symbolic reasoning system, rule-based systems, the AI approach. Knowledge representation. Expert systems

UNIT II ARTIFICIAL NEURAL NETWORKS 9

UNIT III GENETIC ALGORITHM 9
Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and ant-colony search techniques for solving optimization problems.

UNIT IV FUZZY LOGIC SYSTEM 9

UNIT V ADVANCED LEARNING 9

COURSE OUTCOMES:
Upon Completion of the course, the students will be able to
CO1. Understand the various intelligence concepts available in the mechatronics system.
CO2. Demonstrate and design any mechatronics system with artificial neural networks
CO3. Select and implement appropriate techniques and genetic algorithm
CO4. Design and implement the real time application with fuzzy logic.
CO5. Familiar with advanced learning techniques

TOTAL: 45 PERIODS
REFERENCES:
1. Padhy, N.P. (2005), Artificial Intelligence and Intelligent System, Oxford University Press.

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>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>AVG.</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

MR4205 SMART EMBEDDED SYSTEMS

COURSE OBJECTIVES:
1. To understand the inclusion of embedded system in smart system design
2. To learn and understand the basic concepts in ARM 7 Core processor
3. To learn and understand the basic concepts in ARM 9 Core processor
4. To impart knowledge on real time models, language and operating systems
5. To demonstrate the embedded processors and various applications of embedded systems

UNIT I MICROCONTROLLER

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

UNIT III INTRODUCTION TO ARM PROCESSOR

UNIT IV REAL TIME MODELS, LANGUAGE AND OPERATING SYSTEMS
Models and languages – State Machine and state tables in embedded design – High level language descriptions - Java based embedded system design – Petrinet models-Real time languages – The real time Kernel - OS tasks - Task Scheduling - kernel services – Real time languages and their features.

UNIT V OTHER PROCESSORS AND APPLICATIONS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon Completion of the course, the students will be able to

CO1. Understand and implement embedded technologies in the field of smart system design.
CO2. Understand and interface the peripherals with 8051.
CO3. Design, program and implement ARM 7 and ARM 9 based system.
CO4. Familiarize and select real time models, language and operating system in their system design.
CO5. Demonstrate various applications of embedded systems in various fields.

REFERENCES:
6. Tim Wilmshurst, An Introduction to the design of small – scale Embedded Systems.

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>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>AVG.</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:
1. To introduce different types of robotics and demonstrate them to identify different parts and components.
2. To write programming for simple operations.
3. To write program for identification and recognition of object parameters.

LIST OF EXPERIMENTS
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.
7. Robot programming and simulation for machining (cutting, welding).
8. Robot programming and simulation for writing practice.
9. Robot programming and simulation for any industrial process (Packaging, Assembly).
10. Robot programming and simulation for multi process.
11. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
12. Program to construct a Bayesian network. Use this model to implement any application using standard Data Set. You can use Java/Python ML library classes/API.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 18 STUDENTS
1. ROS (Robotic Operating System)
2. 18 Systems with server
3. Verification of direct kinematics equations and inverse kinematics equations of 1DOF “R-configuration” robot.
4. Verification of direct kinematics equations and inverse kinematics equations of 2DOF “R-R-configuration” robot.

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

CO1. Apply any robotic simulation software to model the different types of robots and calculate work volume for different robots.

CO2. Analyse and estimate the various robotic specifications.

CO3. Create program for object identification and recognition, machining operation and simulate the same in any robotic simulation software.
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>-</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>-</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>-</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>AVG.</td>
<td>-</td>
<td>1.3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

MR4212      MACHINE VISION AND INTELLIGENCE LABORATORY      L T P C
0 0 4 2

COURSE OBJECTIVES:
1. To gather the practical exposure on machine vision elements, lighting technique, processing software and algorithms.
2. To learn and practice various image processing techniques.
3. To learn various application of machine vision and programming

LIST OF EXPERIMENTS
1. Study on different kinds of vision sensors.
2. Study on lighting techniques for machine vision
4. Experimentation on image acquisition towards the computation platform.
5. Pre-processing techniques in image processing.
6. Edge detection and region of interest extraction.
7. Experimentation with image processing algorithm for feature extraction.
8. Experimentation with pattern recognition.
10. Vision based Gear parameter measurement.
12. Implement the SIFT blob detector and tracker
13. Object recognition by SIFT, SURF

LIST OF EQUIPMENT FOR A BATCH OF 18 STUDENTS
1. CMOS Camera (USB/Ethernet) - 1 No
2. CCD Camera (USB/Ethernet) - 1 No
3. Standard Boom Stand (Bench top setup) - 2 No's
4. Extension Tube (5mm to 50mm) - 2 No's
5. Lenses (between 3mm to 50mm focal length) - 2 No's
6. Tele-centric lens - 1 No
7. Lighting (Coaxial, ring lighting, Diffused, backlighting) - 1 No Each.
8. Machine vision software - 2 No's
9. PC-2 No's

TOTAL: 60 PERIODS
COURSE OUTCOMES:
Upon the completion of this course, the students will be able to:

CO1. To select a vision sensor for any kind of application.

CO2. To understand and implement various image processing techniques.

CO3. To understand and implement industrial applications.

CO-PO MAPPING:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>PO</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></td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>AVG.</td>
<td></td>
<td>1.3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

MR4311 PROJECT WORK - I

COURSE OBJECTIVES:
1. To enable students to select and define a problem/need for analysis in the field of mechatronic and its interdisciplinary area based on the complexity of the problem.
2. To review and analyse literature/data of selected problem for study and propose objective and scope of dissertation work.
3. To develop hypothesis and identify methodology based on ethical, scientific and systematic application of knowledge in the proposed field of dissertation work.
4. To design, model and experiment/develop optimal solution for problem being investigated.
5. To analysis and interpretation of system and its performance, data, and synthesis of the information to provide valid conclusions and submit dissertation.

EVALUATION:
1. A project topic may be selected based on the literature survey and the creative ideas of the students themselves in consultation with their project supervisor. The topic should be so chosen that it will improve and develop the skills in design, modelling, simulation, developing algorithms, fabrication and integration of system elements for automation and research. Literature survey and a part of the project work be carried out in Phase–I.
2. The progress of the project is evaluated based on a minimum of three reviews and review committee may be constituted by the Head of the Department.
3. The project work is evaluated jointly by external and internal examiners constituted by anna university based on oral presentation and the project report.
4. A project report for dissertation-I is to be submitted at the end.
5. Project work evaluation is based on the Regulations of the Credit system for the Post graduate programmes of Anna University Obtain Fourier transforms for the functions which are needed for solving application problems.

TOTAL: 180 PERIODS
COURSE OUTCOMES:
CO1 - The students would apply the knowledge gained from theoretical and practical courses in solving problems
CO2 - The students would be able to create a novel mechatronics-based solution for an engineering problem and get trained in planning, organizing and executing the method.
CO3 – The students would be able to analyse and evaluate the result and can be able to record and write a technical document in form of thesis.

CO-PO MAPPING:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>PO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PO1</td>
</tr>
<tr>
<td>CO1</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td>2</td>
</tr>
</tbody>
</table>

MR4411 PROJECT WORK - II

COURSE OBJECTIVES:
1. The students will be able to propose and define a problem/need for development and analysis in the field of mechatronic and its interdisciplinary area and it may be a continuation phase - I or newly formulated problem for phase - I.
2. To comprehensively review and analyse literature/ data to develop hypothesis and identify methodology based on ethical, scientific and systematic application of knowledge in the field of problem.
3. To design, modelling, simulation, developing algorithms, fabrication and integration of system elements for automation for development of sustainable and economical solution for problem being investigated.
4. To analyse and interpretation of system and its performance, data, and synthesize of the factual information’s to arrive at valid conclusions
5. To enable students to communicate technical information in form of oral presentation and technical report in form of dissertation

EVALUATION:
1. The progress of the project is evaluated based on a minimum of three reviews.
2. The review committee may be constituted by the Head of the Department.
3. A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the anna university based on oral presentation and the project report.
4. Project work evaluation is based on the Regulations of the Credit system for Post graduate programmes of Anna University.

TOTAL: 180 PERIODS
COURSE OUTCOMES:
CO1 - The students would apply the knowledge gained from theoretical and practical courses in solving problems.
CO2 - The students would be able to create a novel mechatronics-based solution for an engineering problem and get trained in planning, organizing and executing the method.
CO3 – The students would be able to analyse and evaluate the result and can be able to record and write a technical document in form of thesis.

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>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Avg.</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:
1. To familiar the measurement standards and to know the instruments used and various errors in measurements
2. To recognize the use of basic and advanced instruments for measurements.
3. To learn the applications of opto-electronics device for measurements.
4. To observe the machine vision-based inspections.
5. To acquire the measurement strategies in inspection using CMM.

UNIT I FUNDAMENTALS AND CONCEPTS IN METROLOGY
Standards of measurement – Analog and digital measuring instruments-comparators – Limits, Fits and Tolerances – Gauge design – Angular measurements – Surface Roughness – Form errors and measurements.

UNIT II INSPECTION AND GENERAL MEASUREMENTS

UNIT III OPTO ELECTRONICS IN ENGINEERING INSPECTION
Use of opto electronics in Tool wear measurement – Micro hole measurement and surface Roughness – Applications in In-Process measurement and on line Inspection.

UNIT IV MACHINE VISION

UNIT V COORDINATE METROLOGY AND QUALITY CONTROL
Co-ordinate measuring machines – Applications and case-studies of CMM in Inspection – Use of Computers in quality control – Control charts – Reliability.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
At the end of the course, students will be able to
Upon completion of this course, the students will be able to:
CO1: Evaluate the standards in measurements and to avoid the various forms of errors in measurements.
CO2: Apply of basic and advanced metrology instruments for measurements.
CO3: Acquire the knowledge on non-contact opto-electronics device for measurements.
CO4: Apply machine vision-based inspections.
CO5: Create the measurement strategies in inspection using CMM

REFERENCES
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>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>AVG.</td>
<td>1.8</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2.4</td>
<td>2.2</td>
</tr>
</tbody>
</table>

MR4002 DIGITAL MANUFACTURING

COURSE OBJECTIVES
1. To learn the concept of NC and CNC technologies on practical problems with feedback and adaptive control.
2. To learn the configuration of CNC system, PLC programming for CNC and also case studies on machine structure elements.
3. To learn the mechatronics elements in CNC measuring system and tooling system, EEPROM tools, automatic tool changing system, tool magazine and sensors in CNC.
4. To learn about the CNC programming tools with computer assisted programming using APT, generation and execution of APT programs.
5. To learn the methods for verification, testing and Maintenance of CNC machines during idle running and machine tooling.

UNIT I INTRODUCTION OF NC, CNC, DNC AND ADAPTIVE CONTROL
Classification of machine tools – types, functions and processes - fundamentals of NC and CNC technologies Adaptive control - types, application and benefits - general configuration of adaptive control and function – reasons for process change - practical problems with adaptive control - example for feedback and adaptive control.

UNIT II MECHATRONIC ELEMENTS IN CNC MACHINE TOOLS
CNC systems - configuration of the CNC system – interfacing – monitoring – diagnostics - machine data - compensations for machine accuracies - PLC in CNC – PLC programming for CNC, steps in programming and case studies - machine structure -types of loads on CNC machine - guide ways and types - mechanical transmission elements - elements for rotary motion to linear motion - ball screw and types - roller screw and types - rack and pinion - various torque transmission elements - requirements of feed drives and spindle drive.
UNIT III MECHATRONICS ELEMENT IN CNC MEASURING SYSTEM AND TOOLING


UNIT IV CNC PROGRAMMING


UNIT V TESTING AND MAINTENANCE OF CNC MACHINES


TOTAL : 45 PERIODS

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:
CO1: Get the knowledge of the differences of NC, CNC and DNC.
CO2: Analyse architecture of CNC and to identify the mechatronic elements and its functions in CNC machine reliable performance.
CO3: Realize the functions of instrumentation systems
CO4: Write the part programming in CNC machine.
CO5: Perform the testing and maintenance of various sub systems of CNC

REFERENCES

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>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>AVG.</td>
<td>1.8</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2.4</td>
<td>2.2</td>
</tr>
</tbody>
</table>

MR4003 COMPUTER AIDED PRODUCTION AND AUTOMATION OF PLANTS

COURSE OBJECTIVES
1. To learn various production planning processes, capacity planning, and shop floor planning processes.
2. To learn about the fundamentals of Automated assembly and part transferring systems.
3. To learn about Group Technology and Flexible manufacturing systems.
4. To learn about automation systems and advanced manufacturing techniques.
5. To familiarize computer-aided production and automation of plants through various case studies.

UNIT I COMPUTER AIDED PRODUCTION PLANNING

UNIT II AUTOMATED MATERIAL TRANSFER AND STORAGE SYSTEM

UNIT III GROUP TECHNOLOGY AND FLEXIBLE MANUFACTURING SYSTEMS
UNIT IV  AUTOMATION SYSTEMS AND ADVANCED MANUFACTURING 9

TECHNIQUES

UNIT V  CASE STUDIES 9

TOTAL : 45 PERIODS

COURSE OUTCOMES:
At the end of the course, students will be able to
1. Understand various production planning processes, capacity planning, and shop floor planning processes
2. Understand the fundamentals of Automated assembly and part transferring systems.
3. Understand the concepts of Group Technology and Flexible manufacturing systems.
4. Understand about automation systems and advanced manufacturing techniques.
5. Apply the concepts of “computer aided production and automation” in various manufacturing industries.

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

REFERENCES
COURSE OBJECTIVES
1. To introduce the students about basic concepts, practices, standard data, terminology and symbols for designing.
2. To learn the design procedures of shafts and couplings to withstand various loads.
3. To learn the design procedures of transmission components to transfer power and to withstand various loads.
4. To introduce the students about basic concepts of product development.
5. To learn the basic formulation of finite element analysis for various components.

UNIT I INTRODUCTION
Introduction to national and international symbols- Engineering materials and their physical properties and applied to design- Selection of materials- selection for new design and material considerations-Factors of safety in design- Dimensioning and detailing- Fitness and tolerance- Surface finish and machining symbols –Product development- Elementary concept of functional, aesthetic and form design- Principles of design optimization- Future trends- CAD.

UNIT II STATIC AND VARIABLE STRESSES
Static and variable loading in machine elements- Stress concentration- Goodman and soderberg method of design- Design of power transmission shafts- Subjected to torsion, bending and axial loads- Design of close coiled helical spring -Design of couplings- Muff, Flange, Bushed and pin types.

UNIT III DESIGN OF TRANSMISSION ELEMENTS

UNIT IV PRODUCT DESIGN AND DEVELOPMENT
Quality function development (QFD) - product design and specification, design for manufacturability (DFM), design for assembly and disassembly, human factors in design ergonomics, creativity in design, TRIZ- axiomatic design.

UNIT V FINITE ELEMENT ANALYSIS
Basic Concept of FEA - finite element analysis of one dimensional and two dimensional problems- variational formulation of B.V.P. – Ritz Method-Examples related to one-dimensional and two-dimensional problems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students can able to
1. Understand the basic concepts, practices, standard data, terminology and symbols for designing.
2. Create the shafts and couplings for given various types of loads.
3. Create the transmission components to transfer given power and to withstand various types of loads.
4. Understand the basics concepts of product development.
5. Analyze and formulate finite element equations for some general machine components.
REFERENCES

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

MR4005 MULTI-BODY DYNAMICS L T P C 3 0 0 3

COURSE OBJECTIVES
1. To understand the important concepts of multi-body dynamics.
2. To familiar the various computational methods multi-body dynamics.
3. To characterize the nonlinear concepts of multi-body dynamics.
4. To recognize the need of control in nonlinear dynamics multi body interactions.
5. To interpret the nonlinear dynamics of multi body systems and its realization of control.

UNIT I INTRODUCTION TO DYNAMICS

UNIT II COMPUTATIONAL METHODS FOR DYNAMIC ANALYSIS
UNIT III NONLINEAR SYSTEMS AND CONCEPTS

UNIT IV SYSTEM CHARACTERIZATION

UNIT V CONTROL OF NONLINEAR MECHANICAL SYSTEMS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: Apply the important concepts in multi-body dynamics.
CO2: Create mathematical model for capturing the dynamics of multi-body interactions.
CO3: Understand the nonlinear behaviour of multi-body dynamics.
CO4: Evaluate the control in nonlinear dynamics of multi body interactions.
CO5: Apply control for the nonlinear behaviour of multi body systems.

REFERENCES

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

TOTAL: 45 PERIODS
COURSE OBJECTIVES
1. To understand the basics of single board computers.
2. To learn about real-time operating system.
3. To get knowledge on python programming basics.
4. To learn to embed python in various hardware
5. To learn various case studies of python and onboard computers.

UNIT I  INTRODUCTION TO SINGLE BOARD COMPUTERS  9

UNIT II  REAL TIME OPERATING SYSTEM  9

UNIT III  PYTHON PROGRAMMING  9

UNIT IV  EMBEDDED PYTHON PROGRAMMING  9

UNIT V  APPLICATIONS  9

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon the completion of this course, the students will be able to;
1. Understand the basics of single board computers.
2. Understand about real-time operating system.
3. Understand basics of python programming.
4. Apply python programming concepts in various hardware.
5. Apply python programming and onboard computer concepts in various systems.

REFERENCES
4. NInad Sathaye, Learning python application development, Packt publishing, 2016
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>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>AVG.</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

MR4007 MICRO AND NANO SYSTEMS

COURSE OBJECTIVES:
1. To introduce to microsystem of MEMS, material and fabrication technique
2. To provide overview of characterization tools for MEMS
3. To create awareness about principles and applications of various sensors
4. To impart knowledge on different kind of Micro-Nano actuators
5. To introduce Bio MEMS, Microfluidic and Nano position system

UNIT I INTRODUCTION TO MICRO AND NANO TECHNOLOGY

UNIT II CHARACTERIZATION OF MATERIALS

UNIT III MICRO AND NANO SENSORS
UNIT IV  MICRO AND NANO ACTUATORS


UNIT V  MICRO AND NANO SYSTEM


TOTAL: 45 PERIODS

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

CO1. Understand material and fabrication involved in Microsystem.
CO2. Explain techniques to visualize and measure geometrical features of MEMS system and chemical composition.
CO3. Select a type of sensors based on application with working knowledge and principles.
CO4. Select a type of factor based on application with knowledge of working principle.
CO5. Discuss on Micro fluidic, Bio MEMS and Nano position systems.

REFERENCES:

CO-PO MAPPING:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>PO</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></td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>AVG.</td>
<td></td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES
- To recall the fundamentals of PID control and familiar various performance measures used in control systems.
- To interpret the single loop control and it's tuning.
- To model, analyze the system in state space and its observer design in detail
- To familiar the nonlinear control system and its concepts.
- To learn the functions and used of various control methodology.

UNIT - I CONTROLLER AND PERFORMANCE MEASURES

UNIT - II ENHANCEMENT TO SINGLE LOOP CONTROL

UNIT - III STATE SPACE ANALYSIS

UNIT – IV NONLINEAR SYSTEMS AND CONTROL

UNIT - V OTHER CONTROL METHODS

TOTAL: 45 PERIODS

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

CO1: Develop the PID control and capable to analyze performances of the control systems.
CO2: Know the functions of various types of single loop control and its tuning.
CO3: Examine the system in state space and its observer design in detail
CO4: Approach the nonlinear control system and its concepts.
CO5: Recognize the uses of various control methodology.

<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>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>AVG.</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
REFERENCES:

MR4009 BIOMECHATRONICS

COURSE OBJECTIVES
- To familiarize the fundamentals of biomechanics.
- To characterize and relate the behaviours of skeletal and muscular systems for engineering solutions.
- To understand the servomechanism of biological systems.
- To design artificial structural elements for replacements.
- To simulate and develop the applications of bio-mechatronics.

UNIT-I BIOMECHANICS

UNIT-II MECHANICS IN SKELETAL AND MUSCULAR SYSTEM

UNIT-III CONTROL MECHANISM OF BIOLOGICAL SYSTEMS
Skeletal Muscles Servo Mechanism, Cardio Vascular Control Mechanism, Respiratory Control Mechanism – Interfacing Techniques with Natural Servo Mechanism.

UNIT-IV PROSTHETIC AND ORTHOTIC DEVICES
UNIT - V SIMULATION AND MODELLING OF BIOMECHANTRONICS


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

CO1: Know the fundamentals of biomechanics.
CO2: Describe and relate the behaviours of skeletal and muscular systems
CO3: Realize the servomechanism of biological systems for bio mechatronics development.
CO4: Design the artificial bio Mehatronics systems.
CO5: Establish and develop the applications of bio mechatronics.

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

REFERENCES
COURSE OBJECTIVES:
1. To understand electrical actuator steady state operation and transient dynamics of a motor load system.
2. To learn the operation and construction of solid-state switching devices.
3. To study the operation of various D.C Motor drives and to select appropriate drive for speed and position control.
4. To study the operation of various A.C Motor drives and to select appropriate drive for speed control.
5. To study the operation of various Special Motor drives.

UNIT I  ELECTRICAL ACTUATORS AND DRIVE CHARACTERISTICS

UNIT II  SOLID STATE SWITCHING DEVICES
Solid State Relay - Switching Characteristics - Bipolar Junction Transistor (BJT), Metal Oxide Semiconductor - Field Effect Transistor Silicon Controlled Rectifier (SCR) - DIAC- TRIAC- Gate Turn-Off Thyristor (GTO) – Insulated Gate Bipolar Transistor (IGBT) - Classification of PWM Techniques.

UNIT III  D.C. MOTOR DRIVES

UNIT IV  A.C. MOTOR DRIVES

UNIT V  SPECIAL ELECTRICAL MOTOR DRIVES

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, the students will be able to:
CO1. Understand electrical actuator steady state operation and transient dynamics of a motor load system.
CO2. Select suitable solid-state switching devices.
CO3. Identify and apply appropriate drive for speed and position control for various D.C Motors.
CO4. Identify and apply appropriate drive for speed control for various A.C Motors.
CO5. Select suitable drives for special motors.
REFERENCES:

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

MR4011 AUTOMOTIVE ELECTRONICS

OBJECTIVES:

- To impart knowledge to the students in the principles of operation and constructional details of various Automotive Electrical and Electronic Systems
- To understand the need for starter batteries, starter motor and alternator in the vehicle.
- To differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control unit using different communication protocols
- To list common types of sensor and actuators used in vehicles.
- To understand dash – Board Instruments, various sensors and networking in vehicles.

UNIT I FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS
Components for an electronic engine management system, open and closed-loop control strategies, PID control, Lookup tables, introduction to modern control strategies like Fuzzy logic and adaptive control. Switches, active resistors, Transistors, Current mirrors/amplifiers, Voltage and current references, Comparator, Multiplier. Amplifier, filters, A/D and D/A converters.

UNIT II ELECTRONIC SENSORS IN AUTOMOBILE
Throttle position, mass air flow, crankshaft position, cam position, engine speed sensor, exhaust oxygen level (two step, linear lambda and wideband), knock, manifold temperature, and pressure sensors. Solenoid, relay (four and five pins), stepper motor

UNIT III ELECTRONIC COMPONENTS FOR ENGINE CONTROL
Cold start and warm-up phases, idle speed control, acceleration and full load enrichment, deceleration fuel cut-off. Fuel control maps, open loop and closed-loop control – Integrated engine control system, Electromagnetic compatibility – EMI Suppression techniques – Electronic dashboard instruments – Onboard diagnosis system.
UNIT IV  ELECTRONIC COMPONENTS FOR IGNITION AND INJECTION SYSTEMS

UNIT V  MICROPROCESSOR IN AUTOMOBILES
Microprocessor and Microcomputer controlled devices in automobiles such as instrument clusters, Voice warning systems, Travel information systems, and Keyless entry system. Environmental requirements (vibration, Temperature, and EMI).

OUTCOMES:
At the end of this course the student should be able to
- Explain the fundamentals, operation, function of various sensors and actuators in engine management systems.
- Define the glossary related to vehicle electrical and electronic system
- Understand the need for starter batteries, starter motor, and alternator in the vehicle.
- Differentiate the conventional and modern vehicle architecture and the data transfer among the different electronic control units using different communication protocols
- List common types of sensors and actuators used in vehicles.
- Understand networking in vehicles.

CO PO MAPPING:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>PO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PO1</td>
</tr>
<tr>
<td>CO1</td>
<td>1</td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>1</td>
</tr>
<tr>
<td>AVG.</td>
<td>1</td>
</tr>
</tbody>
</table>

REFERENCES:
MR4012 UNMANNED AERIAL VEHICLE

COURSE OBJECTIVES:
1. To understand the basic concepts of UAVs.
2. To learn and understand the various components of UAVs.
3. To familiarize the basic concepts of flights.
4. To impart knowledge on maintenance of drone equipment.
5. To understand the various regulatories and regulations.

UNIT I INTRODUCTION TO UNMANNED AERIAL VEHICLES (UAV) 9
Overview and background: history of UAVs, classifications of UAVs, lift generation method. Contemporary applications like military, government and civil areas. Operational considerations like liability / legal issues, ethical implications LOS / BLOS

UNIT II UNMANNED AERIAL SYSTEM (UAS) COMPONENTS 9

UNIT III BASIC CONCEPTS OF FLIGHT 9

UNIT IV DRONE EQUIPMENT MAINTENANCE 9
Maintenance of drone, flight control box - Maintenance of ground equipment- batteries - Scheduled servicing - Repair of equipment - Fault finding and rectification - Weather and meteorology.

UNIT V REGULATORIES AND REGULATIONS 9
Homeland regulatories: FCC, FAA and foreign regulatory. Regulations: FCC compliance, UAS registration, Federal Aircraft Regulations (FARs) - Safety considerations

TOTAL: 45 PERIODS

COURSE OUTCOMES
Upon completion of this course, the students will be able to:
CO1. Understand and familiarize the basic concepts on UAVs
CO2. Select and choose the components of UAV
CO3. Understand the basic concepts of flight
CO4. To maintain the drone equipment.
CO5. To understand various regulatories and regulations.

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>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>AVG.</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
REFERENCES:

MR4013 INTELLIGENT PRODUCT DESIGN  
L T P C  
3 0 0 3  

COURSE OBJECTIVES:
1. To understand the basics of intelligent design and manufacturing.
2. To learn and understand the knowledge representation techniques.
3. To learn and understand the intelligent product modelling techniques.
4. To demonstrate the applications of neural networks.
5. To study the applications of internet based collaborative CAD/CAM.

UNIT – I INTRODUCTION TO INTELLIGENT DESIGN AND MANUFACTURING  
Need - Internet technology and Manufacturing Industry - Digital enterprises - Manufacturing portals – Benefits.

UNIT – II TECHNIQUES OF KNOWLEDGE REPRESENTATION  

UNIT – III INTELLIGENT PRODUCT MODELING TECHNIQUES  
Intelligent CAD systems, integrating product and process design, manufacturing analysis and CAD/CAM integration, design methodology for automated manufacture, the impacts of intelligent process control on product design, and fuzzy knowledge-based controller design.

UNIT – IV APPLICATION OF NEURAL NETWORKS  
Neural Networks for Intelligent Process Monitoring and Control : Applications to CNC machining, Metal Forming - Intelligent Manufacturing Planning, Scheduling and Control - Intelligent Assembly and Layout Planning.

UNIT – V INTERNET BASED COLLABORATIVE CAD/CAM  
Applications to web based CAD, CAPP, CNC, Assembly planning, and Rapid Prototyping - Challenging issues of Collaborative CAD/CAM.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Identify and understand the intelligent design and manufacturing.
2. Familiarize the knowledge representation techniques.
3. Understand the various techniques in intelligent product modeling.
4. Demonstrate the applications of neural networks
5. Apply internet on collaborative CAD/CAM
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>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>CO5</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>AVG.</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

REFERENCES:

IL4073 HUMAN INDUSTRIAL SAFETY AND HYGIENE L T P C
3 0 0 3

OBJECTIVES:
- Identify and prevent operational hazard
- Categorize, analyze and interpret the accidents data based on various safety techniques.
- Use proper safety techniques on safety engineering and management.
- Design the system with environmental consciousness by implementing safety regulation
- Use safety management practices in Industries.

UNIT I OPERATIONAL SAFETY

UNIT II SAFETY APPRAISAL AND ANALYSIS
UNIT III  OCCUPATIONAL HEALTH

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


UNIT V  SAFETY MANAGEMENT


OUTCOMES:
CO1: Ability to Identify and prevent operational hazard
CO2: Ability to collect, analyze and interpret the accidents data based on various safety techniques.
CO3: Ability to apply proper safety techniques on safety engineering and management.
CO4: Ability to design the system with environmental consciousness by implementing safety regulation
CO5: Ability to apply safety management practices in Industries.

REFERENCES:

CO-PO MAPPING

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO4</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Avg.</td>
<td>(1+2)/2=1.5</td>
<td>(1+2)/2=1.5</td>
<td>2/1=2</td>
<td>(1+1)/2=1</td>
<td>(1+1+1)/3=1</td>
<td>(1+1)/2=1</td>
</tr>
</tbody>
</table>

1-low, 2-medium, 3-high, ′-′- no correlation
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
Design challenges in IoT -Standardization, Security and privacy, Infrastructure, Analytics. Design steps for implementing IoT.

UNIT III PROTOTYPING OF IoT

UNIT IV PREREQUISITES FOR IoT
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
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>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>(5/5)=1</td>
</tr>
</tbody>
</table>

MR4014 COMMUNICATION PROTOCOLS

COURSE OBJECTIVES
1. To study the various types wired protocols for electronic system.
2. To know the various types wireless protocols for electronic system.
3. To aware the various industrial wired protocols in automation.
4. To study the various types wireless protocols for industrial automation.
5. To develop the wired and wireless functions of various protocols

UNIT – I WIRED BUSES AND PROTOCOLS

UNIT – II WIRELESS PROTOCOLS

UNIT – III INDUSTRIAL AND AUTONOMOUS SYSTEMS WIRED NETWORKS

UNIT – IV INDUSTRIAL WIRELESS NETWORKS
Overview of Industrial Wireless Networks - IWLAN - ISA100 Standards – Remote Networks-Controller-Based Networks - Wireless HART Technology - 3G/4G for Automation – RFID Data Tags.

UNIT – V APPLICATION OF COMMUNICATION PROTOCOLS
COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Design wired protocols for electronic system.
2. Use wireless protocols for electronic system.
3. Practice industrial wired protocols in automation.
4. Select wireless protocols for industrial automation.
5. Demonstrate the wired and wireless functions of various protocols in application development.

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

REFERENCES:

MR4015 ADVANCED COMPUTER VISION
L T P C
3 0 0 3

COURSE OBJECTIVES
1. To understand the various fundamental mathematics behind computer vision algorithms.
2. To expose students to various image formation and camera calibration techniques.
3. To expose students to various 3D surface reconstruction algorithms.
4. To impart knowledge on stereo vision and structure from motion.
5. To impart knowledge on applying the computer vision techniques to robots.

UNIT – I BASIC CONCEPTS FOR COMPUTER VISION
UNIT – II  IMAGE FORMATION AND CAMERA CALIBRATION

Projective Geometry - Imaging through lenses and pin-hole – Basic Photometry – Basic model of imaging geometry – Ideal Camera – Camera with intrinsic parameters – Approximate camera models – Camera Calibration – Methods and Procedure

UNIT – III  SURFACE RECONSTRUCTION TECHNIQUES

Depth Perception in Humans, Cues – Shape from Texture, Shading, Focus, Defocus, Structured Light Reconstruction – Time of Flight Methods

UNIT – IV  COMPUTATIONAL STEREO AND MOTION


UNIT – V  ROBOT VISION


TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1: Understand the basic concepts behind computer vision algorithms.

CO2: Understand various image formation and camera calibration techniques.

CO3: Understand various 3D surface reconstruction algorithms.

CO4: Understand stereo vision and structure from motion.

CO5: Apply the computer vision techniques to robots

CO-PO MAPPING:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>PO</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></td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>AVG.</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
REFERENCES:

MR4016    MECHATRONICS IN AERO SYSTEMS    L  T  P  C
          3  0  0  3

COURSE OBJECTIVES
1. To learn about the aircraft system and its automation requirements.
2. To learn about various sensors, measurement, actuators, navigation systems and its control of aircraft systems.
3. To learn various actuators and other mechanisms related to aircraft.
4. To understand the stability and control of an aircraft.
5. To learn about GPS and other navigation techniques used in aircraft.

UNIT – I  OVERVIEW OF AIRCRAFT ENGINEERING  9

UNIT – II  SENSORS AND MEASUREMENTS  9

UNIT – III  MECHANISMS AND ACTUATORS  9

UNIT – IV  STABILITY AND CONTROL  9
UNIT – V  NAVIGATION


TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon the completion of this course, the students will be able to;
1. Understand the aircraft system and its automation requirements.
2. Understand various sensors, measurement, actuators, navigation systems and its control of aircraft systems.
3. Understand various actuators and other mechanisms related to aircraft.
4. Understand the stability and control of an aircraft.
5. Understand GPS and other navigation techniques used in aircraft.

CO-PO MAPPING:

<table>
<thead>
<tr>
<th>Course Outcomes</th>
<th>PO</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></td>
<td>1</td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>AVG.</td>
<td></td>
<td>1</td>
<td></td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

REFERENCES:

MR4017  MEDICAL MECHATRONICS  L  T  P  C

|             | 3  | 0  | 0  | 3 |

COURSE OBJECTIVES
1. To know the various types of human functional system and basic human functional measurement instrumentations.
2. To understand the mechatronic elements in various assisting and therapeutics equipment.
3. To realize the integrations of in cardiac and regulatory functions assist systems.
4. To acquire the architecture and functions of medical imaging equipment.
5. To introduce the sensory assist devices and automated analysed in medical field.
UNIT – I    INTRODUCTION TO MEDICAL MECHATRONICS

UNIT – II   ASSISTING AND THERAPEUTIC EQUIPMENTS

UNIT – III   CARDIAC AND REGULATORY ASSIST SYSTEM

UNIT – IV    MEDICAL IMAGING

UNIT – V    SENSORY ASSIST DEVICES AND AUTOMATED ANALYZER

TOTAL: 42 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: Understand the uses of human functional measurement instrumentations.
CO2: Evaluate the mechatronic elements in various assisting and therapeutics equipment.
CO3: Apply the integrations of in cardiac and regulatory functions assist systems.
CO4: Understand the elements and functions of medical imaging equipment.
CO5: Evaluate the appropriate sensory assist devices and automated analysed in medical field.

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

62
REFERENCES:

MR4018 MOBILE ROBOTICS

COURSE OBJECTIVES
1. To introduce mobile robotic technology and its types in detail.
2. To learn the kinematics of wheeled and legged robot.
3. To familiarize the intelligence into the mobile robots using various sensors.
4. To acquaint the localization strategies and mapping technique for mobile robot.
5. To aware the collaborative mobile robotics in task planning, navigation and intelligence.

UNIT – I INTRODUCTION TO MOBILE ROBOTICS

UNIT – II KINEMATICS

UNIT – III PERCEPTION

UNIT – IV LOCALIZATION
UNIT – V PLANNING, NAVIGATION AND COLLABORATIVE ROBOTS


TOTAL: 45 PERIODS

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

**CO1:** Evaluate the appropriate mobile robots for the desired application.

**CO2:** Create the kinematics for given wheeled and legged robot.

**CO3:** Analyse the sensors for the intelligence of mobile robotics.

**CO4:** Create the localization strategies and mapping technique for mobile robot.

**CO5:** Create the collaborative mobile robotics for planning, navigation and intelligence for desired applications.

**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>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>AVG.</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

REFERENCES:

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 9
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 9

UNIT – III ENERGY SAVING MACHINERY AND COMPONENTS 9

UNIT – IV HAZARDOUS AND SOLID WASTE MANAGEMENT 9

UNIT – V GREEN CO-RATING 9

TOTAL: 45 PERIODS

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

MR4019 HAPTICS AND AUGMENTED REALITY L T P C
3 0 0 3

COURSE OBJECTIVES
1. To identify the terminologies of haptic devices.
2. To understand the structure of haptic system and to aware the tele-operation for various applications.
3. To acquire the knowledge on modelling for haptic system development relevant to the human.
4. To emphasize the significance of knowledge in virtual and augmented reality.
5. To know the concepts and hardware of mixed reality.

UNIT – I INTRODUCTION TO HAPTICS
Definition - Importance of Touch - Tactile Proprioception - Tactual Stereo Genesis - Kinesthetic Interfaces - Tactile Interfaces - Human Haptics - Overview of Existing applications - Basics of Force Feedback Devices - Kinesthetic Vs. Tactile Haptic Devices - Configurations of Kinesthetic Devices - Types of Kinesthetic Devices

UNIT – II KINESTHETIC HAPTIC DEVICES AND TELEOPERATION
UNIT – III  HUMAN HAPTICS ITS PLATFORM


UNIT – IV  VIRTUAL AND AUGMENTED REALITY


UNIT – V  MIXED REALITY


TOTAL: 45 PERIODS

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

CO1. Recognize the haptic technology and its concepts in various haptic systems.
CO2. Classify the elements of haptics system and tele-operation in detail.
CO3. Design and use the devices in human haptic applications.
CO4. Combine and build the virtual and augmented reality-based models.
CO5. Develop the design and model the hardware of mixed reality.

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

REFERENCES:
MR4020 INDUSTRIAL INSTRUMENTATION AND CONTROL L T P C
3 0 0 3

COURSE OBJECTIVES
1. To understand the overview of the industrial automation and control.
2. To familiarize with data communication and supervisory control systems.
3. To learn and understand the basic concepts of factory automation.
4. To understand various control elements in industry.
5. To understand and select final control element for process control.

UNIT – I INDUSTRIAL INSTRUMENTATION

UNIT – II DATA COMMUNICATION AND SUPERVISORY CONTROL SYSTEMS

UNIT – III FACTORY AUTOMATION
Factory Layout - Tools and Software Based Factory Modelling - Case Study on Automated Manufacturing Units, Assembly Unit, Inspection Systems and PLC Based Automated Systems - Introduction to Factory Automation Monitoring Software.

UNIT – IV CONTROL ELEMENTS

UNIT – V FINAL CONTROL ELEMENTS
I/P converter - Pneumatic and electric actuators – Valve Positioner – Control Valves – Characteristic of Control Valves:- Inherent and Installed characteristics – Modeling of pneumatic control valve – Valve body:-Commercial valve bodies – Control valve sizing – Cavitation and flashing – Selection criteria.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Understand the concepts of industrial instrumentation.
2. Select and design a system with data communication and supervisory control.
3. Understand the concepts and layout of automation in factory.
4. Understand the various control elements in industry.
5. Evaluate and select control elements for the system design.

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

REFERENCES:

MR4021 MODELING AND ANALYSIS OF ELECTRO MECHANICAL SYSTEMS
L T P C
3 0 0 3

COURSE OBJECTIVES
1. To equip students with fundamentals of finite element principles.
2. To enable them to understand the behavior of various finite elements and to be able to select appropriate elements to solve physical and engineering problems to emphasis on structural, thermal, Electrical and fluid engineering applications.
3. To make them to understand to shape functions and higher order formulation.
4. To learn various quantities in engineering problems and also make them to work on preprocessing, meshing, boundary condition assigning and post processing.
5. To make them to work on real time problem by giving various case studies and explore them to the FEM software available in the market.
UNIT – I  
**FINITE ELEMENT MODELLING**

UNIT – II  
**ONE DIMENSIONAL ANALYSIS**

UNIT – III  
**SHAPE FUNCTIONS AND HIGHER ORDER FORMULATIONS**

UNIT – IV  
**ELECTROMECHANICAL SYSTEMS AND IMPLEMENTATION**

UNIT – V  
**CASE STUDIES**

**TOTAL: 45 PERIODS**

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

**CO1:** Understand the fundamentals of finite element principles.  
**CO2:** Evaluate and select appropriate elements to solve Physical and Engineering problem in structural, thermal, Electrical and fluid engineering applications.  
**CO3:** Understand shape functions and higher order formulation.  
**CO4:** Evaluate and select appropriate element, boundary condition, meshing and Post processing for any engineering problem.  
**CO5:** Create FEM model on various software packages used for FEM analysis tool to analyse a production process through FEA and control it’s parameters.

**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>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>AVG.</strong></td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
REFERENCES:

AUDIT COURSES

AX4091 ENGLISH FOR RESEARCH PAPER WRITING L T P C
2 0 0 0

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

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

UNIT II PRESENTATION SKILLS 6

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

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

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

TOTAL: 30 PERIODS
COURSE OUTCOMES
CO1 – Understand 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

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

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

OBJECTIVES

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

UNIT I    HISTORY OF MAKING OF THE INDIAN CONSTITUTION

History, Drafting Committee, (Composition & Working)

UNIT II    PHILOSOPHY OF THE INDIAN CONSTITUTION

Preamble, Salient Features

UNIT III    CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

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

AX4094 தகவில் துங்கியேயும் L T P C
2 0 0 0

UNIT I துன்கியேயும் 6
1. துங்கியேயும் துன்கியேயும் துங்கியேயும் 
- நேராயன், தேவர், பாருகல்
2. அகத்தாழை (82) 
- பொழித்தாகத் திருத்தில்லாத அகத்தாழை
3. துங்கியேயும் பாருகல் பாருகல் 
4. பாருகல் (95,195)
UNIT II
அரசியல் குறிப் 6
1. அரசியல் துறை சிற்றுறைகள்
   - அரசியல் செயலாளர், கட்டுப்பாடு செயலாளர், ஒப்புறவு செயலாளர், அவர்களின் பணிகள்
2. பெண் அரசியல் - ஒளக்குறிப்
   - அரசியல், தேசியத் துறை, குப்பைகள், சேர்க்கைகள் (சுமார் மூன்று வருடத்திற்கு மாடு)

UNIT III
தொன்கல் கம்பிப்பூண்ணிகள் 6
1. கலந்துச்சிப்பியாளர் பருத்தி
   - கலந்துச்சிப்பியாளர் வழிபாடுகள்
2. குழுக்கோட்டைச் செயலாளர் பார்வைச்செயலாளர்
   - குழுக்கோட்டைச் செயலாளர் வழிபாடுகள்

UNIT IV
அல்லந்திகள் குறிப் 6
1. சிற்றுறையாளர் பொதுப்பொருள்
   - பொதுப்பொருள் செயலாளர், குமார் மற்றும் பார்வைச்செயலாளர் ஆகியோர் வழிபாடுகள்
2. குழுக்கோட்டை
   - அரசியல் பொதுச் சிற்றுறை
3. சிற்றுறைச் செயலாளர் (617, 618)
   - சிற்றுறைச் செயலாளர் வழிபாடு
4. சுற்றுநிலைகள் பொதுச் சிற்றுறை வழிபாடு
5. பொதுத்தொடர்
   - சிற்றுறைச் சிற்றுறை வழிபாடு
6. அரசியல் (4) - சிற்றுறை
   - சிற்றுறை குழுக்கோட்டை (11) - சிற்றுறை
   - காலந்தொடர் (11) - மாநில பொது
   - வழி காலந்தொடர் (50 (27) - மாநில
c   - சுற்றுநிலை பொதுச் சிற்றுறை

UNIT V
சுற்றுநிலை சிற்றுறையாளர் 6
1. சுற்றுநிலைச் சிற்றுறை, குழுக்கோட்டை, பொதுத் தொடர் வழிபாடுகளுடன், குழுக்கோட்டை செயலாளரின், குழுக்கோட்டைச் செயலாளரின், பொதுத் தொடர் செயலாளரின், பொதுத் தொடர் செயலாளரின் வழிபாடுகளுடன்
- நொடகம்,
2. நொட்டு விடுதகல பபொரொட்டமும் தமிழ் இலக்கியமும்,
3. முதொய விடுதகலயும் தமிழ் இலக்கியமும்,
4. தபண் விடுதகலயும் விளிம்பு நிகலயினரின் பமம்பொட்டில் தமிழ் இலக்கியமும்,
5. அறிவியல் தமிழ்,
6. தொலைவியல் தமிழ்,
7. குறுக்குடுது செய்மயப்படுத்து தமிழ் இலக்கியம்.

TOTAL: 30 PERIODS

தமிழ் இலக்கிய புத்தகங்கள் / புத்தகாய்ந்தகங்கள்
1. தமிழ் விலங்கா விலங்கிகுரியம் (Tamil Virtual University)
   - www.tamilvu.org
2. தமிழ் விக்கிப்பீடி (Tamil Wikipedia)
   - https://ta.wikipedia.org
3. தர்மபுர ஆதின் வழிவுத்துற
4. வகுக்கிள்கம் கருத்துப்பாடு
   - தமிழ் பல்கலைக்கழகம், கொள்ளல்
5. தமிழ் வசுவார்த்திக் காலப் (thamilvalarchithurai.com)
6. அறிவியல் கருத்துப்பாடு
   - தமிழ் பல்கலைக்கழகம், கொள்ளல்
# 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></td>
<td>OCE431</td>
<td>Integrated Water Resources Management</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>27.</td>
<td>OCE432</td>
<td>Water, Sanitation and Health</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>28.</td>
<td>OCE433</td>
<td>Principles of Sustainable Development</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>29.</td>
<td>OCE434</td>
<td>Environmental Impact Assessment</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>30.</td>
<td>OIC431</td>
<td>Blockchain Technologies</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>31.</td>
<td>OIC432</td>
<td>Deep Learning</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>32.</td>
<td>OBA431</td>
<td>Sustainable Management</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>33.</td>
<td>OBA432</td>
<td>Micro and Small Business Management</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>34.</td>
<td>OBA433</td>
<td>Intellectual Property Rights</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>35.</td>
<td>OBA434</td>
<td>Ethical Management</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>36.</td>
<td>ET4251</td>
<td>IoT for Smart Systems</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>37.</td>
<td>ET4072</td>
<td>Machine Learning and Deep Learning</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>38.</td>
<td>PX4012</td>
<td>Renewable Energy Technology</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>39.</td>
<td>PS4093</td>
<td>Smart Grid</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>40.</td>
<td>CP4391</td>
<td>Security Practices</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>41.</td>
<td>MP4251</td>
<td>Cloud Computing Technologies</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>42.</td>
<td>IF4072</td>
<td>Design Thinking</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>43.</td>
<td>MU4153</td>
<td>Principles of Multimedia</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>44.</td>
<td>DS4015</td>
<td>Big Data Analytics</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>45.</td>
<td>NC4201</td>
<td>Internet of Things and Cloud</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>46.</td>
<td>MX4073</td>
<td>Medical Robotics</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>47.</td>
<td>VE4202</td>
<td>Embedded Automation</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>48.</td>
<td>CX4016</td>
<td>Environmental Sustainability</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>49.</td>
<td>TX4092</td>
<td>Textile Reinforced Composites</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>50.</td>
<td>NT4002</td>
<td>Nanocomposite Materials</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>51.</td>
<td>BY4016</td>
<td>IPR, Biosafety and Entrepreneurship</td>
<td>L 3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>52.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**OCE431 INTEGRATED WATER RESOURCES MANAGEMENT**

| L T P C | 3 0 0 3 |

77
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.

TOTAL: 45 PERIODS

OUTCOMES

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

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

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 Knowledge of Engineering Sciences</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>PO2 Problem analysis</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>PO3 Design / development of solutions</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO4 Investigation</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>PO5 Modern Tool Usage</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO6 Individual and Team work</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO7 Communication</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO8 Engineer and Society</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO9 Ethics</td>
<td>2</td>
<td>3</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>1</td>
<td>1</td>
</tr>
<tr>
<td>PO12 Life Long Learning</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PSO1 Knowledge of field research methodology, gender, legal and environmental aspects in the context of integrated water resources management</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>PSO2 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>
<td>2</td>
</tr>
<tr>
<td>PSO3 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>
<td>2</td>
</tr>
</tbody>
</table>

**OCE432 WATER, SANITATION AND HEALTH**

**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.

TOTAL: 45 PERIODS

OUTCOMES:

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

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></td>
<td>CO1</td>
</tr>
<tr>
<td>PO1</td>
<td>Knowledge of Engineering Sciences</td>
<td>1</td>
</tr>
<tr>
<td>PO2</td>
<td>Problem analysis</td>
<td>2</td>
</tr>
<tr>
<td>PO3</td>
<td>Design / development of solutions</td>
<td>2</td>
</tr>
<tr>
<td>PO4</td>
<td>Investigation</td>
<td>2</td>
</tr>
<tr>
<td>PO5</td>
<td>Modern Tool Usage</td>
<td>2</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>3</td>
</tr>
<tr>
<td>PO9</td>
<td>Ethics</td>
<td>1</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>3</td>
</tr>
<tr>
<td>PO12</td>
<td>Life Long Learning</td>
<td>2</td>
</tr>
<tr>
<td>PSO1</td>
<td>Explain the concepts of water</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>management, field research</td>
<td></td>
</tr>
<tr>
<td></td>
<td>methodology, gender, legal and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>environmental aspects in the</td>
<td></td>
</tr>
<tr>
<td></td>
<td>context of integrated water</td>
<td></td>
</tr>
<tr>
<td></td>
<td>resources management</td>
<td></td>
</tr>
<tr>
<td>PSO2</td>
<td>Formulate, analyse and comprehend</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>the differences in social and</td>
<td></td>
</tr>
<tr>
<td></td>
<td>economic variability in South</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Asian context with their peers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>and strive to work towards</td>
<td></td>
</tr>
<tr>
<td></td>
<td>sustainability.</td>
<td></td>
</tr>
<tr>
<td>PSO3</td>
<td>Produce and publish professional</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>reports, peer reviewed journal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>on contemporary and state of art</td>
<td></td>
</tr>
<tr>
<td></td>
<td>research in water resources</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Engineering.</td>
<td></td>
</tr>
</tbody>
</table>

### OCE433 PRINCIPLES OF SUSTAINABLE DEVELOPMENT

| L T P C |
|---------|--------|--------|--------|--------|
| 3 0 0 3 |

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

**UNIT I SUSTAINABILITY AND DEVELOPMENT CHALLENGES**

UNIT II PRINCIPLES AND FRAME WORK


UNIT III SUSTAINABLE DEVELOPMENT AND WELLBEING


UNIT IV SUSTAINABLE SOCIO-ECONOMIC SYSTEMS


UNIT V ASSESSING PROGRESS AND WAY FORWARD


OUTCOMES:

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

| CO1 | Explain and evaluate current challenges to sustainability, including modern world social, environmental, and economic structures and crises. |
CO2  Identify and critically analyze the social environmental, and economic dimensions of sustainability in terms of UN Sustainable development goals.

CO3  Develop a fair understanding of the social, economic and ecological linkage of Human well being, production and consumption.

CO4  Evaluate sustainability issues and solutions using a holistic approach that focuses on connections between complex human and natural systems.

CO5  Integrate knowledge from multiple sources and perspectives to understand environmental limits governing human societies and economies and social justice dimensions of sustainability.

REFERENCES:

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></td>
<td>CO1</td>
<td>CO2</td>
</tr>
<tr>
<td>PO1 Knowledge of Engineering Sciences</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO2 Problem analysis</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO3 Design / development of solutions</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO4 Investigation</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO5 Modern Tool Usage</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO6 Individual and Team work</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO7 Communication</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO8 Engineer and Society</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO9 Ethics</td>
<td>2</td>
<td>2</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>3</td>
<td>3</td>
</tr>
<tr>
<td>PO12 Life Long Learning</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PSO1 Knowledge of Environmental Management discipline</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PSO2 Environmental Performance Evaluation and coordination</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PSO3 Conceptualization of Environmental Management Systems</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
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  9

UNIT II       IMPACT IDENTIFICATION AND PREDICTION 10

UNIT III      SOCIO-ECONOMIC IMPACT ASSESSMENT 8
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 9
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 9
Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects

TOTAL: 45 PERIODS

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

<table>
<thead>
<tr>
<th>CO1</th>
<th>Understand need for environmental clearance, its legal procedure, need of EIA, its types, stakeholders and their roles</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO2</td>
<td>Understand various impact identification methodologies, prediction techniques and model of impacts on various environments</td>
</tr>
<tr>
<td>CO3</td>
<td>Understand relationship between social impacts and change in community due to development activities and rehabilitation methods</td>
</tr>
<tr>
<td>CO4</td>
<td>Document the EIA findings and prepare environmental management and monitoring plan</td>
</tr>
<tr>
<td>CO5</td>
<td>Identify, predict and assess impacts of similar projects based on case studies</td>
</tr>
</tbody>
</table>

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

CO – PO Mapping- ENVIRONMENTAL IMPACT ASSESSMENT

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>Course Outcome</th>
<th>Overall Correlation of COs to Pos</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CO1</td>
<td>CO2</td>
</tr>
<tr>
<td>PO1 Knowledge of Engineering Sciences</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO2 Problem analysis</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>PO3 Design / development of solutions</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>PO4 Investigation</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>PO5 Modern Tool Usage</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>PO6 Individual and Team work</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>PO7 Communication</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>PO8 Engineer and Society</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>PO9 Ethics</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>PO10 Environment and Sustainability</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>PO11 Project Management and Finance</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>PO12 Life Long Learning</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>PSO1 Knowledge of Environmental Engineering discipline</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>PSO2 Environmental Performance Evaluation and coordination</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>PSO3 Conceptualization of Environmental Engineering Systems</td>
<td>2</td>
<td></td>
</tr>
</tbody>
</table>

COURSE OBJECTIVES:
- This course is intended to study the basics of Blockchain technology.
- During this course the learner will explore various aspects of Blockchain technology like application in various domains.
- By implementing, learners will have idea about private and public Blockchain, and smart contract.

UNIT I INTRODUCTION OF CRYPTOGRAPHY AND BLOCKCHAIN
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>2</td>
<td>3</td>
<td>2</td>
<td>2</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>Avg</td>
<td>2.00</td>
<td>1.00</td>
<td>2.50</td>
<td>2.25</td>
<td>2.00</td>
</tr>
</tbody>
</table>

86
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
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
Management of sustainability - rationale and political trends: An introduction to sustainability management, International and European policies on sustainable development, theoretical pillars in sustainability management studies.

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

UNIT III SUSTAINABILITY MANAGEMENT: STRATEGIES AND APPROACHES
Corporate sustainability management and competitiveness: Sustainability-oriented corporate strategies, markets and competitiveness, Green Management between theory and practice, Sustainable Consumption and Green Marketing strategies, Environmental regulation and strategic postures; Green Management approaches and tools; Green engineering: clean technologies and innovation processes; Sustainable Supply Chain Management and Procurement.

UNIT IV SUSTAINABILITY AND INNOVATION
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

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

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

UNIT I INTRODUCTION TO SMALL BUSINESS 9

UNIT II SCREENING THE BUSINESS OPPORTUNITY AND FORMULATING THE BUSINESS PLAN 9
Concepts of opportunity recognition; Key factors leading to new venture failure; New venture screening process; Applying new venture screening process to the early stage small firm Role planning in small business – importance of strategy formulation – management skills for small business creation and development.
UNIT III  BUILDING THE RIGHT TEAM AND MARKETING STRATEGY  9
Management and Leadership – employee assessments – Tuckman’s stages of group
development - The entrepreneurial process model - Delegation and team building - Comparison
of HR management in small and large firms - Importance of coaching and how to apply a
coaching model.
Marketing within the small business - success strategies for small business marketing -
customer delight and business generating systems, - market research, - assessing market
performance- sales management and strategy - the marketing mix and marketing strategy.

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

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

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
small and medium-sized enterprise in Australia.” Australian Journal of Political Science
3. Journal articles on SME’s.

MAPPING OF POs AND COs

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>CO4</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
OBA433  INTELLECTUAL PROPERTY RIGHTS  L T P C 3 0 0 3

COURSE OBJECTIVE
➢ To understand intellectual property rights and its valuation.

UNIT I  INTRODUCTION  9
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>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>3</td>
<td></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>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>CO5</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

91
COURSE OBJECTIVE
➢ To help students develop knowledge and competence in ethical management and decision making in organizational contexts.

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

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

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

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

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

TOTAL: 45 PERIODS

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

REFERENCES

MAPPING OF POs AND COs
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 RASPerry PI and Arduino.

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

**TOTAL: 45 PERIODS**

**COURSE OUTCOMES:**
At the end of this course, the students will have the ability to

CO1: Analyze the concepts of IoT and its present developments.

CO2: Compare and contrast different platforms and infrastructures available for IoT

CO3: Explain different protocols and communication technologies used in IoT

CO4: Analyze the big data analytic and programming of IoT

CO5: Implement IoT solutions for smart applications

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Avg.</td>
<td>1.75</td>
<td>2</td>
<td>2.33</td>
<td>2.33</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

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

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

UNIT II NEURAL NETWORKS
Differences between Biological and Artificial Neural Networks - Typical Architecture, Common
Activation Functions, Multi-layer neural network, Linear Separability, Hebb Net, Perceptron,
Adaline, Standard Back propagation Training Algorithms for Pattern Association - Hebb rule and
Delta rule, Hetero associative, Auto associative, Kohonen Self Organising Maps, Examples of
Feature Maps, Learning Vector Quantization, Gradient descent, Boltzmann Machine Learning.

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

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

TOTAL : 45 PERIODS
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>
<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>3</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Avg.</td>
<td></td>
<td>2.42</td>
<td>3</td>
<td>2.57</td>
<td>-</td>
<td>3</td>
<td>-</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 renewable energy sources, Potentials – Achievements – Applications.

UNIT II SOLAR PHOTOVOLTAICS

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


UNIT V OTHER RENEWABLE ENERGY SOURCES

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

TOTAL : 45 PERIODS

OUTCOMES:
After completion of this course, the student will be able to:

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

REFERENCES:

CO-PO MAPPING :

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td></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>
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>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>3</td>
<td>2</td>
<td>-</td>
<td>2</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>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>AVG</td>
<td></td>
<td>2.25</td>
<td>2</td>
<td>1.66</td>
<td>2.25</td>
<td>2.3</td>
<td>2</td>
</tr>
</tbody>
</table>

CP4391 SECURITY PRACTICES

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

UNIT I  SYSTEM SECURITY

UNIT II  NETWORK SECURITY

UNIT III  SECURITY MANAGEMENT

UNIT IV  CYBER SECURITY AND CLOUD SECURITY

UNIT V  PRIVACY AND STORAGE SECURITY

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

<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></td>
<td>2</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  L T P C
3 0 0 3

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

UNIT I VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE 6

UNIT II CLOUD PLATFORM ARCHITECTURE 12

UNIT III AWS CLOUD PLATFORM - IAAS 9

UNIT IV PAAS CLOUD PLATFORM 9

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

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
Introduction. UX goals. UX target tables. Work roles, user classes, and UX goals. UX measures. Measuring instruments. UX metrics. Baseline level. Target level. Setting levels. Observed
results. Practical tips and cautions for creating UX targets. How UX targets help manage the user experience engineering process.

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
Compression Types and Techniques: CODEC, Text Compression: GIF Coding Standards, JPEG standard – JPEG 2000, basic audio compression – ADPCM, MPEG Psychoacoustics,

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

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

**UNIT V  MULTIMEDIA APPLICATIONS FOR THE WEB AND MOBILE PLATFORMS**


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

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

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

**CO1:** Handle the multimedia elements effectively.

**CO2:** Articulate the concepts and techniques used in multimedia applications.

**CO3:** Develop effective strategies to deliver Quality of Experience in multimedia applications.

**CO4:** Design and implement algorithms and techniques applied to multimedia objects.

**CO5:** Design and develop multimedia applications following software engineering models.

**REFERENCES:**

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

UNIT I INTRODUCTION TO BIG DATA
9

UNIT II SEARCH METHODS AND VISUALIZATION
9

UNIT III MINING DATA STREAMS
9

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

UNIT V R LANGUAGE
9

COURSE OUTCOMES:
CO1: understand the basics of big data analytics
CO2: Ability to use Hadoop, Map Reduce Framework.
CO3: Ability to identify the areas for applying big data analytics for increasing the business outcome.
CO4: gain knowledge on R language
CO5: Contextually integrate and correlate large amounts of information to gain faster insights.
TOTAL: 45 PERIODS
REFERENCE:

<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 3 0 0 3

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

UNIT I FUNDAMENTALS OF IoT

UNIT II PROTOCOLS FOR IoT

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

UNIT IV CLOUD COMPUTING INTRODUCTION

UNIT V IoT AND CLOUD

TOTAL:45 PERIODS

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

REFERENCES

MX4073 MEDICAL ROBOTICS

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

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

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

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

Navigation and Treatment Planning
Variable speed arrangements, Path determination – Machinery vision, Ranging – Laser – Acoustic, Magnetic, fiber optic and Tactile sensor
UNIT III  SURGICAL ROBOTS
Da Vinci Surgical System, Image guided robotic systems for focal ultrasound based surgical applications, System concept for robotic Tele-surgical system for off-pump, CABG surgery, Urologic applications, Cardiac surgery, Neuro-surgery, Pediatric and General Surgery, Gynecologic Surgery, General Surgery and Nanorobotics. Case Study

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

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

TOTAL: 45 PERIODS

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

REFERENCES

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
VE4202 EMBEDDED AUTOMATION L T 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 9
C Overview and Program Structure - C Types, Operators and Expressions - C Control Flow - C Functions and Program Structures - C Pointers And Arrays - FIFO and LIFO - C Structures - Development Tools

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

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

UNIT – IV VISION SYSTEM 9

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

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

REFERENCES

REFERENCES

TOTAL : 45 PERIODS

UNIT I  REINFORCEMENTS
Introduction – composites –classification and application; reinforcements- fibres and its properties; preparation of reinforced materials and quality evaluation; preforms for various composites

UNIT II  MATRICES
Preparation, chemistry, properties and applications of thermoplastic and thermoset resins; mechanism of interaction of matrices and reinforcements; optimization of matrices

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

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

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

TOTAL: 45 PERIODS

NT4002  NANOCOMPOSITE MATERIALS  L T P C
        3 0 0 3

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 Vepřek (Review Article) JVST A, 1999

BY4016 IPR, BIOSAFETY AND ENTREPRENEURSHIP  L T P C

UNIT I IPR 9

UNIT II AGREEMENTS, TREATIES AND PATENT FILING PROCEDURES 9

UNIT III BIOSAFETY 9

UNIT IV GENETICALLY MODIFIED ORGANISMS 9
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 9
Development Programmes (EDP) - Launching Of Small Enterprise - Definition, Characteristics – Relationship between small and large units – Opportunities for an Entrepreneurial career – Role of small enterprise in economic development – Problems of small scale industries – Institutional finance to entrepreneurs - Institutional support to entrepreneurs.

TOTAL : 45 PERIODS

REFERENCES