I TO IV SEMESTERS CURRICULA & SYLLABI

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

<table>
<thead>
<tr>
<th>PEO</th>
<th>Programme Educational Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>Possess a mastery of Health safety and environment awareness and safety management skills, to reach higher levels in their profession.</td>
</tr>
<tr>
<td>II.</td>
<td>Proficient safety Engineer rendering professional expertise to the industrial and societal needs at national and global level subject to legal requirements.</td>
</tr>
<tr>
<td>III.</td>
<td>Well communicate the information on Health safety and environment facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering activities.</td>
</tr>
<tr>
<td>IV.</td>
<td>Demonstrate professional and ethical attitude with awareness of current legal issues by rendering expertise to wide range of industries.</td>
</tr>
</tbody>
</table>

PROGRAMME OUTCOMES (POs):

<table>
<thead>
<tr>
<th>PO #</th>
<th>Programme Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>An ability to independently carry out research/investigation and development work to solve practical problems</td>
</tr>
<tr>
<td>2</td>
<td>An ability to write and present a substantial technical report/document</td>
</tr>
<tr>
<td>3</td>
<td>Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program</td>
</tr>
<tr>
<td>4</td>
<td>Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to safety, health and environmental engineering activities with an understanding of the limitations.</td>
</tr>
<tr>
<td>5</td>
<td>Demonstrate the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to occupational health and safety practices.</td>
</tr>
<tr>
<td>6</td>
<td>Recognise the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously</td>
</tr>
</tbody>
</table>

PEO/PO Mapping:

<table>
<thead>
<tr>
<th>PEO</th>
<th>PO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>I.</td>
<td></td>
</tr>
<tr>
<td>II.</td>
<td>2</td>
</tr>
<tr>
<td>III.</td>
<td>2</td>
</tr>
<tr>
<td>IV.</td>
<td>2</td>
</tr>
<tr>
<td>COURSE NAME</td>
<td>PO1</td>
</tr>
<tr>
<td>--------------------------------------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>Probability and Statistical Methods</td>
<td>3</td>
</tr>
<tr>
<td>Principles of Safety Management</td>
<td>3</td>
</tr>
<tr>
<td>Environmental Safety</td>
<td>3</td>
</tr>
<tr>
<td>Occupational Health and Industrial Hygiene</td>
<td>3</td>
</tr>
<tr>
<td>Industrial Safety, Health and Environment Acts</td>
<td>3</td>
</tr>
<tr>
<td>Research Methodology and IPR</td>
<td></td>
</tr>
<tr>
<td>Professional Elective - I</td>
<td></td>
</tr>
<tr>
<td>Safety Audit</td>
<td>2.5</td>
</tr>
<tr>
<td>Fire Engineering and Explosion Control</td>
<td>3</td>
</tr>
<tr>
<td>System Simulation and Hazard Analysis</td>
<td>3</td>
</tr>
<tr>
<td>Electrical Safety</td>
<td>3</td>
</tr>
<tr>
<td>Safety in Process Industries</td>
<td>3</td>
</tr>
<tr>
<td>Professional Elective II</td>
<td>2</td>
</tr>
<tr>
<td>Professional Elective III</td>
<td></td>
</tr>
<tr>
<td>Industrial Safety and Simulation Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>Technical Seminar - I</td>
<td>3</td>
</tr>
<tr>
<td>Reliability Engineering</td>
<td>2</td>
</tr>
<tr>
<td>Professional Elective IV</td>
<td></td>
</tr>
<tr>
<td>Professional Elective V</td>
<td></td>
</tr>
<tr>
<td>Open Elective</td>
<td></td>
</tr>
<tr>
<td>Project work - I</td>
<td></td>
</tr>
<tr>
<td>Industrial Safety Assessment – Internship</td>
<td>2</td>
</tr>
<tr>
<td>Project work- II</td>
<td></td>
</tr>
</tbody>
</table>
# ANNA UNIVERSITY, CHENNAI
NON-AUTONOMOUS COLLEGES AFFILIATED TO ANNA UNIVERSITY
M.E. INDUSTRIAL SAFETY ENGINEERING
REGULATIONS – 2021
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA AND SYLLABUS

## 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><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>MA4114</td>
<td>Probability and Statistical Methods</td>
<td>FC</td>
<td>4 0 0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>IS4101</td>
<td>Principles of Safety Management</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>IS4102</td>
<td>Environmental Safety</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>IS4103</td>
<td>Occupational Health and Industrial Hygiene</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>IS4104</td>
<td>Industrial Safety, Health and Environment Acts</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>RM4151</td>
<td>Research Methodology and IPR</td>
<td>RMC</td>
<td>2 0 0</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td>Professional Elective - I</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>8.</td>
<td></td>
<td>Audit Course – I*</td>
<td>AC</td>
<td>2 0 0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>PRACTICAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>IS4111</td>
<td>Safety Audit</td>
<td>EEC</td>
<td>0 0 2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td>23 0 2</td>
<td>25</td>
<td>22</td>
</tr>
</tbody>
</table>

* Audit Course is optional

## SEMESTER II

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>IS4201</td>
<td>Fire Engineering and Explosion Control</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>IS4202</td>
<td>System Simulation and Hazard Analysis</td>
<td>PCC</td>
<td>4 0 0</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>IS4203</td>
<td>Electrical Safety</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>IS4204</td>
<td>Safety in Process Industries</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>Professional Elective - II</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Professional Elective - III</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td>Audit Course - II*</td>
<td>AC</td>
<td>2 0 0</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>PRACTICAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>IS4211</td>
<td>Industrial Safety and Simulation Laboratory</td>
<td>PCC</td>
<td>0 0 2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>9.</td>
<td>IS4212</td>
<td>Technical Seminar - I</td>
<td>EEC</td>
<td>0 0 2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td>21 0 4</td>
<td>25</td>
<td>21</td>
</tr>
</tbody>
</table>

* Audit Course is optional
### SEMESTER III

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>THEORY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>IS4351</td>
<td>Reliability Engineering</td>
<td>PCC</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>Professional Elective - V</td>
<td>PEC</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4.</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>5.</td>
<td>IS4311</td>
<td>Project Work I</td>
<td>EEC</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>6.</td>
<td>IS4312</td>
<td>Industrial Safety Assessment – Internship</td>
<td>EEC</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><strong>TOTAL</strong></td>
<td></td>
<td>12</td>
<td>0</td>
<td>16</td>
</tr>
</tbody>
</table>

### SEMESTER IV

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L</td>
<td>T</td>
<td>P</td>
</tr>
<tr>
<td>PRACTICAL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>IS4411</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><strong>TOTAL</strong></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>MA4114</td>
<td>Probability and Statistical Methods</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
### PROGRAM 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>1.</td>
<td>IS4101</td>
<td>Principles of Safety Management</td>
<td>3 Lecture 0 Tutorial 0 Practical</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>IS4102</td>
<td>Environmental Safety</td>
<td>3 Lecture 0 Tutorial 0 Practical</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>3.</td>
<td>IS4103</td>
<td>Occupational Health and Industrial Hygiene</td>
<td>3 Lecture 0 Tutorial 0 Practical</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>4.</td>
<td>IS4104</td>
<td>Industrial Safety, Health and Environment Acts</td>
<td>3 Lecture 0 Tutorial 0 Practical</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>5.</td>
<td>IS4201</td>
<td>Fire Engineering and Explosion Control</td>
<td>3 Lecture 0 Tutorial 0 Practical</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>IS4202</td>
<td>System Simulation and Hazard Analysis</td>
<td>4 Lecture 0 Tutorial 0 Practical</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>7.</td>
<td>IS4203</td>
<td>Electrical Safety</td>
<td>3 Lecture 0 Tutorial 0 Practical</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>8.</td>
<td>IS4204</td>
<td>Safety in Process Industries</td>
<td>3 Lecture 0 Tutorial 0 Practical</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>9.</td>
<td>IS4211</td>
<td>Industrial Safety and simulation Laboratory</td>
<td>0 Lecture 0 Tutorial 4 Practical</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>10.</td>
<td>IS4351</td>
<td>Reliability Engineering</td>
<td>3 Lecture 0 Tutorial 0 Practical</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL CREDITS</strong></td>
<td></td>
<td><strong>29</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 Lecture 0 Tutorial 0 Practical</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL CREDITS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### PROFESSIONAL ELECTIVES

#### SEMESTER I, ELECTIVE I

<table>
<thead>
<tr>
<th>SL. NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IL4076</td>
<td>Plant Layout and Material Handling</td>
<td>PEC</td>
<td>3 Lecture 0 Tutorial 0 Practical</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>IS4001</td>
<td>Work Study and Ergonomics</td>
<td>PEC</td>
<td>3 Lecture 0 Tutorial 0 Practical</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>IL4074</td>
<td>Human Factors in Engineering</td>
<td>PEC</td>
<td>3 Lecture 0 Tutorial 0 Practical</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>IS4002</td>
<td>Maintainability Engineering</td>
<td>PEC</td>
<td>3 Lecture 0 Tutorial 0 Practical</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>IS4003</td>
<td>Optimization Techniques</td>
<td>PEC</td>
<td>3 Lecture 0 Tutorial 0 Practical</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
### SEMESTER II, ELECTIVE II & III

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IS4004</td>
<td>Transport Safety</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>IS4005</td>
<td>Fireworks Safety</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>IS4006</td>
<td>Safety in Construction</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>IS4007</td>
<td>Nuclear Engineering and Safety</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>IS4008</td>
<td>Safety in Textile Industry</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>IS4009</td>
<td>Safety in Mines</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>IS4010</td>
<td>Dock Safety</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

### SEMESTER III, ELECTIVE IV & V

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IS4011</td>
<td>Safety in Engineering Industry</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>IS4012</td>
<td>Quality Engineering in Production Systems</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>IS4013</td>
<td>ISO 45001 and ISO 14000</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>IS4014</td>
<td>Artificial Intelligence and Expert Systems</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>6</td>
<td>IL4091</td>
<td>Design of Experiments</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>IS4071</td>
<td>Data Analytics</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

### AUDIT COURSES (AC)

Registration for any of these courses is optional to students

<table>
<thead>
<tr>
<th>SL. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>AX4091</td>
<td>English for Research Paper Writing</td>
<td>2 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>ஏனினரது கையேறியம்</td>
<td>2 0 0</td>
<td>0</td>
</tr>
</tbody>
</table>
### EMPLOYABILITY ENHANCEMENT COURSES (EEC)

<table>
<thead>
<tr>
<th>S. NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
<th>SEMESTER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lecture</td>
<td>Tutorial</td>
<td>Practical</td>
</tr>
<tr>
<td>1.</td>
<td>IS4212</td>
<td>Technical Seminar - I</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>IS4311</td>
<td>Project Work I</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>3.</td>
<td>IS4312</td>
<td>Industrial Safety Assessment – Internship</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>4.</td>
<td>IS4411</td>
<td>Project Work II</td>
<td>0</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>TOTAL CREDITS</strong></td>
<td><strong>21</strong></td>
<td></td>
<td></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>
## SUMMARY

Name of the Programme: M.E

<table>
<thead>
<tr>
<th>SUBJECT AREA</th>
<th>CREDITS PER SEMESTER</th>
<th>CREDITS TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>1. FC</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>2. PCC</td>
<td>12</td>
<td>14</td>
</tr>
<tr>
<td>3. PEC</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>4. RMC</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>5. OEC</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>6. EEC</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>7. Non Credit/Audit Course</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. CC</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>9. TOTAL CREDIT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
MA4114 PROBABILITY AND STATISTICAL METHODS

COURSE OBJECTIVES:
- To provide students with basic concepts of probability theory.
- To provide the most appropriate estimator of the parameter in statistical inference.
- To decide whether to accept or reject a specific value of a parameter.
- To avoid or at least to minimize, the problems of estimating the effects of the independent variable by experimental designs.
- To learn methods for analyzing time series data to extract meaningful statistical characteristic of data.

UNIT I PROBABILITY AND RANDOM VARIABLES

UNIT II ESTIMATION THEORY

UNIT III TESTING OF HYPOTHESIS
- Sampling distributions – Small and large samples and problems – Tests based on Normal, t - distribution, Chi - square, Goodness of fit and F – distributions.

UNIT IV DESIGN OF EXPERIMENTS
- Analysis of variance – Completely randomized design – Randomized block design – Latin square design – 2^2 Factorial designs.

UNIT V TIME SERIES
- Characteristics and representation – Moving averages – Exponential smoothing – Auto regressive processes.

COURSE OUTCOMES:
After completing this course, students should demonstrate competency in the following topics:
- Basic probability axioms and rules and the moments of discrete and continuous random variables.
- Least squares, correlation, regression, consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
- Use statistical tests in testing hypotheses on data.
- List the guidelines for designing experiments and recognize the key historical figures in Design of Experiments.
- Differentiate between various time series models and application of these models appropriately to engineering problems.

TOTAL : 60 PERIODS
REFERENCES:

IS4101 PRINCIPLES OF SAFETY MANAGEMENT

OBJECTIVES:
- To achieve an understanding of principles of safety management.
- To enable the students to learn about various functions and activities of safety department.
- To enable students to conduct safety audit and write audit reports effectively in auditing situations.
- To have knowledge about sources of information for safety promotion and training.
- To familiarize students with evaluation of safety performance.

UNIT I CONCEPTS AND TECHNIQUES

UNIT II SAFETY AUDIT
Components of safety audit, types of audit, audit methodology, non-conformity reporting (NCR), audit checklist and report – review of inspection, remarks by government agencies, consultants, experts – perusal of accident and safety records, formats – implementation of audit indication - liaison with departments to ensure co-ordination – check list – identification of unsafe acts of workers and unsafe conditions in the shop floor.

UNIT III ACCIDENT INVESTIGATION AND REPORTING

UNIT IV SAFETY PERFORMANCE MONITORING
ANSI (Z16.1) Recommended practices for compiling and measuring work injury experience – permanent total disabilities, permanent partial disabilities, temporary total disabilities - Calculation of accident indices, frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, safety “t” score, safety activity rate – problems.
UNIT V SAFETY EDUCATION AND TRAINING


OUTCOMES:
The students will be able to

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

REFERENCES:

7. Relevant Indian Standards and Specifications, BIS, New Delhi.

CO-PO MAPPING:

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

1-low, 2-medium, 3-high, ‘-‘-no correlation
OBJECTIVES:
- To provide in depth knowledge in Principles of Environmental safety and its applications in various fields.
- To give understanding of air and water pollution and their control.
- To expose the students to the basis in hazardous waste management.
- To design emission measurement devices.

UNIT I  AIR POLLUTION
Classification and properties of air pollutants – Pollution sources – Effects of air pollutants on human beings, Animals, Plants and Materials - automobile pollution-hazards of air pollution-concept of clean coal combustion technology - ultra violet radiation, infrared radiation, radiation from sun-hazards due to depletion of ozone - deforestation-ozone holes-automobile exhausts-chemical factory stack emissions-CFC.

UNIT II  WATER POLLUTION

UNIT III  HAZARDOUS WASTE MANAGEMENT

UNIT IV  ENVIRONMENTAL MEASUREMENT AND CONTROL
Gravitational settling chambers-cyclone separators-scrubbers-electrostatic precipitator - bag filter – maintenance - control of gaseous emission by adsorption, absorption and combustion methods-Pollution Control Board-laws.

UNIT V  POLLUTION CONTROL IN PROCESS INDUSTRIES

TOTAL: 45 PERIODS

OUTCOMES:
The students will be able to
- Illustrate and familiarize the basic concepts scope of environmental safety.
- Understand the standards of professional conduct that are published by professional safety organizations and/or certification bodies.
- Explain the ways in which environmental health problems have arisen due to air and water pollution.
- Illustrate the role of hazardous waste management and use of critical thinking to identify and assess environmental health risks.
- Discuss concepts of measurement of emissions and design emission measurement devices.
REFERENCES:

CO-PO MAPPING:

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

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

IS4103 OCCUPATIONAL HEALTH AND INDUSTRIAL HYGIENE L T P C 3 0 0 3

OBJECTIVES:
- To understand the basic knowledge on anatomy of human organs and its basic functions.
- To enable the students to learn about various functions and activities of occupational health services.
- To enable students to compare the hazards with the permissible levels.
- To have knowledge about types of hazards arising out of physical, chemical and biological agents.

UNIT I PHYSICAL HAZARDS
Noise, compensation aspects, noise exposure regulation, properties of sound, occupational damage, risk factors, sound measuring instruments, octave band analyzer, noise networks, noise surveys, noise control program, industrial audiometry, hearing conservation programs- vibration, types, effects, instruments, surveying procedure, permissible exposure limit.

Ionizing radiation, types, effects, monitoring instruments, control programs, OSHA standard- non-ionizing radiations, effects, types, radar hazards, microwaves and radio-waves, lasers, TLV- cold environments, hypothermia, wind chill index, control measures- hot environments, thermal comfort, heat stress indices, acclimatization, estimation and control.
UNIT II CHEMICAL HAZARDS
Recognition of chemical hazards-dust, fumes, mist, vapour, fog, gases, types, concentration, Exposure vs. dose, TLV - Methods of Evaluation, process or operation description, Field Survey, Sampling methodology, Industrial Hygiene calculations, Comparison with OSHAS Standard.
Air Sampling instruments, Types, Measurement Procedures, Instruments Procedures, Gas and Vapour monitors, dust sample collection devices, personal sampling
Methods of Control - Engineering Control, Design maintenance considerations, design specifications - General Control Methods - training and education

UNIT III BIOLOGICAL AND ERGONOMICAL HAZARDS
Classification of Biohazardous agents – examples, bacterial agents, rickettsial and chlamydial agents, viral agents, fungal, parasitic agents, infectious diseases – Covid SARS - Biohazard control program, employee health program-laboratory safety program-animal care and handling-biological safety cabinets - building design.
Work Related Musculoskeletal Disorders –carpal tunnel syndrome CTS- Tendon pain-disorders of the neck- back injuries.

UNIT IV OCCUPATIONAL HEALTH AND TOXICOLOGY
Concept and spectrum of health - functional units and activities of occupational health services, pre-employment and post-employment medical examinations - occupational related diseases, levels of prevention of diseases, notifiable occupational diseases such as silicosis, asbestosis, pneumoconiosis, siderosis, anthracosis, aluminosis and anthrax, lead-nickel, chromium and manganese toxicity, gas poisoning (such as CO, ammonia, coal and dust etc) their effects and prevention – cardio pulmonary resuscitation, audiometric tests, eye tests, vital function tests.
Industrial toxicology, local, systemic and chronic effects, temporary and cumulative effects, carcinogens entry into human systems.

UNIT V OCCUPATIONAL PHYSIOLOGY

TOTAL: 45 PERIODS

OUTCOMES:
The students will be able
- To understand the various physiological functions of our body and the test methods for periodical monitoring of health.
- To understand the functions and activities of Occupational health services.
- To identify various types of hazards arising out of physical, chemical and biological agents in a process.
- To identify notifiable occupational diseases arising out of Occupation and suggest methods for the prevention of such diseases.
REFERENCES:

CO-PO MAPPING

<table>
<thead>
<tr>
<th>CO</th>
<th>PO 1</th>
<th>PO 2</th>
<th>PO 3</th>
<th>PO 4</th>
<th>PO 5</th>
<th>PO 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AVg.</td>
<td>3/1=3</td>
<td></td>
<td>(3+2)/2=2.5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

IS4104 INDUSTRIAL SAFETY, HEALTH AND ENVIRONMENT ACTS L T P C 3 0 0 3

OBJECTIVES:
- To provide exposure to the students about safety and health provisions related to hazardous processes as laid out in Factories act 1948.
- To familiarize students with powers of inspectorate of factories.
- To help students to learn about Environment act 1986 and rules framed under the act.
- To provide wide exposure to the students about various legislations applicable to an industrial unit.

UNIT I FACTORIES ACT – 1948

UNIT II ENVIRONMENT ACT – 1986
General powers of the central government, prevention, control and abatement of environmental pollution-Biomedical waste (Management and handling Rules, 1989-The noise pollution (Regulation and control) Rules, 2000-The Batteries (Management and Handling Rules) 2001- No Objection certificate from statutory authorities like pollution control board.

UNIT III MANUFACTURE, STORAGE AND IMPORT OF HAZARDOUS CHEMICAL RULES 1989 AND MAJOR ACCIDENT HAZARD CONTROL RULES AND AMENDMENT 9

UNIT IV OTHER ACTS AND RULES 9

UNIT V INTERNATIONAL ACTS AND STANDARDS 9

OUTCOMES:
The students will be able
- To list out important legislations related to health, Safety and Environment.
- To list out requirements mentioned in factories act for the prevention of accidents.
- To understand the health and welfare provisions given in factories act.
- To understand the statutory requirements for an Industry on registration, license and its renewal.
- To prepare onsite and offsite emergency plan.

REFERENCES:
CO-PO MAPPING

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AVg.</td>
<td>3/1=3</td>
<td>(3+2)/2=2.5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

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

RM4151 RESEARCH METHODOLOGY AND IPR

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

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

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

UNIT IV INTELLECTUAL PROPERTY RIGHTS

UNIT V PATENTS

TOTAL : 30 PERIODS

REFERENCES
OBJECTIVES:
- To Inculcate the Industrial Safety Environment to the students
- To Explore the Human Capital Management and Hazardous System

DESCRIPTION OF THE COURSE
- The students are expected to make a presentation on the state of Safety Audit from the observation from the Industry Safety Department.
- A faculty guide is to be allotted and the Student will visit the industry to aware about the Importance of the Safety.
- Students are encouraged to prepare the Safety System Guidelines from your observation period of Inspection from the Industry Safety Department and contribute the same to the Environment Contribution.
- The Students are advised to go through the below mentioned following heads of safety Measures to be audit and inspect at the time of visit. Depending on the requirements of the organizations, the audit can focus attention on the following aspects of a safety system and make sure that your level of expertise in the safety system.


- Safety Management systems.
- Fire and Explosion prevention, protection and emergency management.
- Work injury prevention.
- Health hazards control.
- Evaluating emergency plan.
- First aid practices
- Management of health and safety
- Accidents and accident reporting
- Asbestos
- Contractors
- Display screen equipment
- Electrical safety
- Emergency lighting
- Environmental protection
- Fire prevention and emergencies
- Hazardous substances
- Housekeeping and cleanliness
- Information and communication
- Kitchens, catering and food safety
- Lifts and lifting equipment
- Manual handling operations
- Noise
- Occupational health
- Personal protective equipment
- Plant rooms, machinery and equipment
- Risk assessment requirements
- Safety Policy
- Safety signs and notices
• Training
• Use of vehicles / vehicle safety
• Water services
• Welfare provision
• Working time
• Work at heights
• Workplace environment
• Accident prevention
• Identifying and correcting Regulatory Deficiencies
• Improvement of Employee Morale
• Identification and Elimination of Safety Hazards

TOTAL: 30 PERIODS

OUTCOMES
The students will be able to
1. To Minimize the Labor turnover by existence of Safety Measures of an Employee.
2. To Promote the Fatigue Study it will lead to good production.
4. To impart the Health Consciousness to the Working Community.

CO-PO MAPPING:

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

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

IS4201   FIRE ENGINEERING AND EXPLOSION CONTROL

OBJECTIVES:
• To provide an in depth knowledge about the science of fire.
• To understand the causes and effects of fire.
• To know the various fire prevention systems and protective equipments.
• To understand the science of explosion and its prevention techniques.
• To understand the various fire prevention techniques to be followed in a building.

UNIT I   PHYSICS AND CHEMISTRY OF FIRE
UNIT II  FIRE PREVENTION AND PROTECTION

UNIT III  INDUSTRIAL FIRE PROTECTION SYSTEMS

UNIT IV  BUILDING FIRE SAFETY
Objectives of fire safe building design, Fire load, fire resistant material and fire testing – structural fire protection – structural integrity – concept of egress design - exists – width calculations - fire certificates – fire safety requirements for high rise buildings – snookers.

UNIT V  EXPLOSION PROTECTING SYSTEMS
Principles of explosion-detonation and blast waves explosion parameters – Explosion Protection, Containment, Flame Arrestors, isolation, suppression, venting, explosion relief of large enclosure explosion venting-inert gases, plant for generation of inert gas-rupture disc in process vessels and lines explosion, suppression system based on carbon dioxide (CO₂) and halons-hazards in LPG, ammonia (NH₃), sulphur dioxide (SO₃), chlorine (CL₂) etc.

TOTAL: 45 PERIODS

OUTCOMES:
• To make familiar about basic concepts of fire and explosion science.
• To know the different source of ignition and their prevention techniques.
• To understand the operation of various types of firefighting equipments.
• To understand the causes and prevention of explosion.
• To equip the students to effectively employ explosion protection techniques and their significances to suit the industrial requirement.

REFERENCES
5. Dinko Tuhtar, “Fire and explosion protection”
**CO-PO MAPPING**

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

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

**IS4202**

**SYSTEM SIMULATION AND HAZARD ANALYSIS**

<table>
<thead>
<tr>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

**OBJECTIVES:**

- To provide knowledge on risk, hazard and their assessment techniques in Industry
- To understand the principles of operation of various equipment for safety application
- To know the consequences of fire, explosion and toxic release
- To know the various software available for risk quantification
- To conduct a risk assessment technique in Industries.

**UNIT I  HAZARD, RISK ISSUES AND HAZARD ASSESSMENT**

Introduction, hazard, hazard monitoring-risk issue, group or societal risk, individual risk, voluntary and involuntary risk, social benefits Vs technological risk, approaches for establishing risk acceptance levels, Risk estimation. Hazard assessment, procedure, methodology; safety audit, checklist analysis, what-if analysis, safety review, preliminary hazard analysis (PHA), human error analysis, hazard operability studies (HAZOP), safety warning systems.

**UNIT II  COMPUTER AIDED INSTRUMENTS**

Applications of Advanced Equipments and Instruments, Thermo Calorimetry, Differential Scanning Calorimeter (DSC), Thermo Gravimetric Analyser (TGA), Accelerated Rate Calorimeter (ARC), Reactive Calorimeter (RC), Reaction System Screening Tool (RSST) - Principles of operations, Controlling parameters, Applications, advantages.

Explosive Testing, Deflagration Test, Detonation Test, Ignition Test, Minimum ignition energy Test, Sensitiveness Test, Impact Sensitiveness Test (BAM) and Friction Sensitiveness Test (BAM), Shock Sensitiveness Test, Card Gap Test.

**UNIT III  RISK ANALYSIS QUANTIFICATION AND SOFTWARES**

Introduction to Discrete and Continuous Systems Simulation- Fault Tree Analysis and Event Tree Analysis, Logic symbols, methodology, minimal cut set ranking - fire explosion and toxicity index (FETI), various indices - Hazard analysis (HAZAN)- Failure Mode and Effect Analysis (FMEA) - Basic concepts of Reliability- Software on Risk analysis, CISCON, FETI, HAMGARS modules on Heat radiation, Pool fire, Jet, Explosion. Reliability softwares on FMEA for mechanical and electrical systems.
UNIT IV  CONSEQUENCES ANALYSIS

Logics of consequences analysis- Estimation- Hazard identification based on the properties of chemicals- Chemical inventory analysis- identification of hazardous processes- Estimation of source term, Gas or vapour release, liquid release, two phase release- Heat radiation effects, BLEVE, Pool fires and Jet fire- Gas/vapour dispersion- Explosion, UVCE and Flash fire, Explosion effects and confined explosion- Toxic effects- Plotting the damage distances on plot plant/layout.

UNIT V  CREDIBILITY OF RISK ASSESSMENT TECHNIQUES

Past accident analysis as information sources for Hazard analysis and consequences analysis of chemical accident, Mexico disaster, Flixborough, Bhopal, Seveso, Pasadena, Feyzin disaster(1966), Port Hudson disaster- convey report, hazard assessment of non-nuclear installation- Rijnmond report, risk analysis of size potentially Hazardous Industrial objects- Rasmussen masses report, Reactor safety study of Nuclear power plant

TOTAL: 60 PERIODS

OUTCOMES:
• This course would make familiarizing of basic concepts in risk and hazard
• Course would be helpful to understand the various instruments to bring safety in Industries
• Students would be trained to find solution for risk assessment studies through the use of software
• Students would be able to make use of a risk assessment technique to quantify the risk
• Course would equip the students effectively to employ hazard analysis techniques in Industry and helpful to prevent the accidents in Industry

REFERENCES
4. Hazop and Hazom, by Trevor A Klett, Institute of Chemical Engineering.
8. Quantitative Risk assessment in Chemical Industries, Institute of Chemical Industries, Centre for Chemical process safety.

CO-PO MAPPING

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AVg.</td>
<td>-</td>
<td>3/1=3</td>
<td>2/1=2</td>
<td>2/1=2</td>
<td>3/1=3</td>
<td>(2+3)/2=2.5</td>
</tr>
</tbody>
</table>

1 - low, 2-medium, 3-high, ““- no correlation
OBJECTIVES:
- To provide knowledge on basics of electrical fire and statutory requirements for electrical safety
- To understand the causes of accidents due to electrical hazards
- To know the various protection systems in Industries from electrical hazards
- To know the importance of earthing
- To distinguish the various hazardous zones and applicable fire proof electrical devices

UNIT I CONCEPTS AND STATUTORY REQUIREMENTS

UNIT II ELECTRICAL HAZARDS
Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity. Energy leakage-clearances and insulation-classes of insulation-voltage classifications-excess energy-current surges-Safety in handling of war equipments-over current and short circuit-current-heating effects of current-electromagnetic forces-corona effect-static electricity-definition, sources, hazardous conditions, control, electrical causes of fire and explosion-ionization, spark and arc-ignition energy-national electrical safety code ANSI.
Lightning, hazards, lightning arrester, installation – earthing, specifications, earth resistance, earth pit maintenance.

UNIT III PROTECTION SYSTEMS
FRLS insulation-insulation and continuity test-system grounding-equipment grounding-earth leakage circuit breaker (ELCB)-cable wires-maintenance of ground-ground fault circuit interrupter-use of low voltage-electrical guards-Personal protective equipment – safety in handling hand held electrical appliances tools and medical equipments.

UNIT IV SELECTION, INSTALLATION, OPERATION AND MAINTENANCE
Role of environment in selection-safety aspects in application – protection and interlock-self diagnostic features and fail safe concepts-lock out and work permit system-discharge rod and earthing devices-safety in the use of portable tools-cabling and cable joints-preventive maintenance.

UNIT V HAZARDOUS ZONES
Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-increase safe equipment-their selection for different zones-temperature classification-grouping of gases-use of barriers and isolators-equipment certifying agencies.

TOTAL: 45 PERIODS

OUTCOMES:
- This course would make familiar of basic concepts in electrical circuit and hazards involved in it.
- Course would be helpful to understand the electrical hazards in Industries.
- Students would be able to understand the operation of various protection systems from electrical hazards
- Recognize different hazardous zones in Industries
REFERENCES
2. Indian Electricity Act and Rules, Government of India.

CO-PO MAPPING

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

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

IS4204

SAFETY IN PROCESS INDUSTRIES

OBJECTIVES:
- To provide knowledge on design features for a process industry and safety in the operation of various equipment in industry.
- To understand the various hazards and prevention in commissioning stage of industry.
- To recognise and identify the safe operation of equipment in process industry.
- To plan and trained for emergency planning in a process industry.
- To get fundamental knowledge on safe storage of chemicals.

UNIT I SAFETY IN PROCESS DESIGN AND PRESSURE SYSTEM DESIGN

Design process, conceptual design and detail design, assessment, inherently safer design- chemical reactor, types, batch reactors, reaction hazard evaluation, assessment, reactor safety, operating conditions, unit operations and equipments, utilities.

Pressure system, pressure vessel design, standards and codes- pipe works and valves- heat exchangers- process machinery- over pressure protection, pressure relief devices and design, fire relief, vacuum and thermal relief, special situations, disposal- flare and vent systems- failures in pressure system.

UNIT II PLANT COMMISSIONING AND INSPECTION

Commissioning phases and organization, pre-commissioning documents, process commissioning, commissioning problems, post commissioning documentation.

Plant inspection, pressure vessel, pressure piping system, non destructive testing, pressure testing, leak testing and monitoring- plant monitoring, performance monitoring, condition, vibration, corrosion, acoustic emission-pipe line inspection.
UNIT III PLANT OPERATIONS
Operating discipline, operating procedure and inspection, format, emergency procedures- hand over and permit system- start up and shut down operation, refinery units- operation of fired heaters, driers, storage- operating activities and hazards- trip systems- exposure of personnel

UNIT IV PLANT MAINTENANCE, MODIFICATION AND EMERGENCY PLANNING
Management of maintenance, hazards- preparation for maintenance, isolation, purging, cleaning, confined spaces, permit system- maintenance equipment- hot works- tank cleaning, repair and demolition- online repairs- maintenance of protective devices- modification of plant, problems- controls of modifications.
Emergency planning, disaster planning, onsite emergency- offsite emergency, APELL

UNIT V STORAGES
General consideration, petroleum product storages, storage tanks and vessel- storages layout- segregation, separating distance, secondary containment- venting and relief, atmospheric vent, pressure, vacuum valves, flame arrestors, fire relief- fire prevention and protection- LPG storages, pressure storages, layout, instrumentation, vapourizer, refrigerated storages- LNG storages, hydrogen storages, toxic storages, chlorine storages, ammonia storages, other chemical storages- underground storages- loading and unloading facilities- drum and cylinder storage- ware house, storage hazard assessment of LPG and LNG

TOTAL: 45 PERIODS

OUTCOMES:
• This course would make familiar of safe design of equipment which are the essential to chemical industry and leads to design of entire process industries.
• Course would be helpful to understand the design of pressure systems.
• Students would understand the problems and find innovative solutions while industries facing problems in commissioning and maintenance stages.
• Students can prepare the emergency planning for chemical industry problems
• Students would be able to create safe storage systems.

REFERENCES
3. Carbide of Calcium Rules, Government of India.

CO-PO MAPPING:

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

1 - low, 2-medium, 3-high, ‘-’- no correlation
OBJECTIVES:
- To provide opportunity to operate the equipment to acquire practical knowledge.
- To know the various PPEs and software.
- To carry out experiments to find out the environmental parameters.
- To assess the impact of sensitivity of chemicals on explosivity.
- To run the software to assess the consequence effects of major accidents.

FIRST AID CONCEPTS
Study of Emergency Kits, First – aid, road safety signs and signals - Safety Software Demo

NOISE LEVEL MEASUREMENT AND ANALYSIS
Measurement of sound pressure level in dB for Impact, continuous and intermittent sources at various networks, peak and average values.

FRICTION TEST
Explosive materials like barium nitrate, gun powder, white powder, amorces composition etc.

IMPACT TEST
Explosive materials like gun powder, white powder, amerce composition etc.
Burst strength test of packaging materials like paper bags, corrugated cartoons, wood etc.
Auto ignition temperature test.

EXHAUST GAS MEASUREMENT AND ANALYSIS
Measurement of Sox, Nox, Cox, hydrocarbons.

ENVIRONMENTAL PARAMETER MEASUREMENT
Dry Bulb Temperature, Wet Bulb Temperature, Determination of relative humidity, wind flow and effective corrective effective.
Particle size Measurement
Air sampling analysis

TRAINING IN USAGE AND SKILL DEVELOPMENT

Personal protective equipment:
Respiratory and non-respiratory-demonstration-self contained breathing apparatus. Safety helmet, belt, hand gloves, goggles, safety shoe, gum boots, ankle shoes, face shield, nose mask, ear plug, ear muff, anti static and conducting plastics/rubber materials, apron and leg guard.

Fire extinguishers and its operations
Water Co₂
Foam
Carbon dioxide (Co₂)
Dry chemical powder and
Currently amendment fire safety systems

Static charge testing on plastic, rubber, ferrous and non-ferrous materials.

Illumination testing - by lux meter and photo meter.
Electrical safety
- Insulation resistance for motors and cables
- Estimation of earth resistance
- Earth continuity test
- Sensitivity test for MCB, ELCB, RCCB, MCCB

Software Usage
- Dispersion modeling of various highly dangerous chemicals using ALOHA software
- SOFTWARE USAGE: Accident Analysis, Safety Audit Packages, Consequence Analysis (CISCON), Fire, Explosion and Toxicity Index (FETI), Reliability Analysis for Mechanical system and Electrical System, Failure Mode Analysis

Experiments on simulation to be added
Discrete and continuous

Equipments Required
1. Noise level meter: 1 No
2. Friction tester: 1 No
3. Impact tester: 1 No
4. Exhaust gas analyzer: 1 No
5. High volume sampler: 1 No
6. PPE Set: 1 No
7. Fire extinguisher set: 1 No
8. Static charge tester: 1 No
9. First aid kid: 1 No
10. Lock out/Tag out: 1 No
11. Software: ALOHA, CAMEO
12. Extend SIM

TOTAL: 30 PERIODS

OUTCOMES:
- This course would make students to know and run the various equipments to bring out the safety environment in the industry.
- Course would be helpful for the students to measure the particulate matter and assess the impact of air pollution.
- Students would be trained to conduct experiments to find out various environmental parameters.
- Students would be able to use personal protective equipment independently.
- Students can recognise the various problems with the use of software and hence to predict the real situations on major accidents.

CO-PO MAPPING:

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

1 - low, 2-medium, 3-high, ‘-‘- no correlation
IS4212 TECHNICAL SEMINAR-I  L T P C  0 0 2 1

OBJECTIVES:
To enrich the communication skills of the student through presentation of topics in recent advances in Industrial safety engineering/technology

OUTCOME:
Students will develop skills to read, write, comprehend and present research papers. Students shall give presentations on recent areas of research in industrial safety engineering in two cycles. Depth of understanding, coverage, quality of presentation material (PPT/OHP) and communication skill of the student will be taken as measures for evaluation.

TOTAL: 30 PERIODS

CO-PO MAPPING:

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

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

IS4351 RELIABILITY ENGINEERING  L T P C  3 0 0 3

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

UNIT I  RELIABILITY CONCEPTS  9

UNIT II  LIFE DATA ANALYSIS  9

UNIT III  RELIABILITY ASSESSMENT  9
Different configurations – Redundancy – k out of n system – Complex systems: RBD – Baye’s approach – Cut and tie sets – Fault Trees – Standby systems.
UNIT IV  RELIABILITY MONITORING  

UNIT V  RELIABILITY IMPROVEMENT  

TOTAL: 45 PERIODS

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

<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>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
<tr>
<td><strong>AVg.</strong></td>
<td><strong>3/1=3</strong></td>
<td><strong>3/1=3</strong></td>
<td><strong>3/1=3</strong></td>
<td><strong>-</strong></td>
<td><strong>2/1=2</strong></td>
<td></td>
</tr>
</tbody>
</table>

REFERENCES:

IS4312  INDUSTRIAL SAFETY ASSESSMENT – INTERNSHIP  
L T P C  0 0 4 2

OBJECTIVES:
- To get an industrial exposure through various industrial environmental experiences and learning safety measures.
- To enhance the collective skills between theoretical knowledge and real-time safety implementations.

GUIDELINES:
- The students are expected to undergo meaningful, practical and hands-on-work experiences related to safety measures through industrial training.
- A faculty guide is to be allotted and he/she will guide and monitor the progress of the Student’s training activities and maintain attendance also.
- Minimum duration of internships period is 3-4 weeks.
- Post internship program, Students should submit a report (within 50 pages) which contains brief observations of training (process, product, layout, safety measures and methods, etc.,) and give a presentation.
- Internship should be evaluated through final presentation with viva-voce exam.

TOTAL: 60 PERIODS

OUTCOMES:
The students will be able to
1. Select and analysis the effective industry safety methods for the given field applications.

CO-PO MAPPING

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

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

IL4076 PLANT LAYOUT AND MATERIAL HANDLING

COURSE OBJECTIVES:
- To provide provided with the knowledge of the process of analyzing and developing information to produce a plant layout based on the locations and working conditions.
- To educate the students about the basic things of work conditions which includes ventilation, comfort, lighting and its effect based on various nature of work.
- To provide knowledge on effective and safe layout design of an industry.

UNIT I PLANT LOCATION
Selection of plant locations, territorial parameters, considerations of land, water, electricity, location for waste treatment and disposal, further expansions
Safe location of chemical storages, LPG, LNG, CNG, acetylene, ammonia, chlorine, explosives and propellants

UNIT II PLANT LAYOUT
Safe layout, equipment layout, safety system, fire hydrant locations, fire service rooms, facilities for safe effluent disposal and treatment tanks, site considerations, approach roads, plant railway lines, security towers.

Safe layout for process industries, engineering industry, construction sites, pharmaceuticals, pesticides, fertilizers, refineries, food processing, nuclear power stations, thermal power stations, metal powders manufacturing, fireworks and match works
UNIT III WORKING CONDITIONS
Principles of good ventilation, purpose, physiological and comfort level types, local and exhaust ventilation, hood and duct design, air conditioning, ventilation standards, application.

Purpose of lighting, types, advantages of good illumination, glare and its effect, lighting requirements for various work, standards- Housekeeping, principles of 5S.

UNIT IV MANUAL MATERIAL HANDLING AND LIFTING TACKLES
Preventing common injuries, lifting by hand, team lifting and carrying, handling specific shape machines and other heavy objects – accessories for manual handling, hand tools, jacks, hand trucks, dollies and wheel barrows – storage of specific materials - problems with hazardous materials, liquids, solids – storage and handling of cryogenic liquids - shipping and receiving, stock picking, dock boards, machine and tools, steel strapping and sacking, glass and nails, pitch and glue, boxes and cartons and car loading – personal protection – ergonomic considerations.

Fiber rope, types, strength and working load inspection, rope in use, rope in storage - wire rope, construction, design factors, deterioration causes, sheaves and drums, lubrication, overloading, rope fitting, inspection and replacement – slings, types, method of attachment, rated capacities, alloy chain slings, hooks and attachment, inspection

UNIT V MECHANICAL MATERIAL HANDLING
Hoisting apparatus, types - cranes, types, design and construction, guards and limit devices, signals, operating rules, maintenance safety rules, inspection and inspection checklist – conveyors, precautions, types, applications.

Powered industrial trucks, requirements, operating principles, operators selection and training and performance test, inspection and maintenance, electric trucks, gasoline operated trucks, LPG trucks – power elevators, types of drives, hoist way and machine room emergency procedure, requirements for the handicapped, types- Escalator, safety devices and brakes, moving walks – man lifts, construction, brakes, inspection.

TOTAL: 45 PERIODS

OUTCOMES:
CO 1: The students will be able to identify equipment requirements for a specific process and for various locations and working conditions.
CO 2: The students will be able to design an efficient material handling system.
CO 3: Understand the difficulties during the design and implementation of the plant layout.
CO 4: Know about material handling requirements and methods
CO 5: Understand the inspection and maintenance techniques.

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>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO3</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CO4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>CO5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>Avg.</td>
<td>(2+2)/2=2</td>
<td>-</td>
<td>-</td>
<td>2/1=2</td>
<td>(2+2)/2=2</td>
<td>-</td>
</tr>
</tbody>
</table>

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

### IS4001 WORK STUDY AND ERGONOMICS

**OBJECTIVES:**
- To study the applications of ergonomic principles and physiology of workers
- To know the concepts of personal protective equipment and its usages
- To create the knowledge in process and equipment design in safety aspects

### UNIT I WORK STUDY

9

### UNIT II ERGONOMICS

9

### UNIT III PERSONAL PROTECTION

9

### UNIT IV PROCESS AND EQUIPMENT DESIGN

9

### UNIT V MAN MACHINE SYSTEMS

9

Man-machine interface-controls -types of control-identification and selection-types of displays-compatibility and stereotypes of important operations-fatigue and vigilance-measurement characteristics and strategies for enhanced performance.

**TOTAL: 45 PERIODS**
OUTCOMES:
The students will be able
1. To know in work procedure and applications in hazardous
2. Incorporate human factors in design of Personal protective equipment
3. Know the risk factors, guide lines for safe design of man machine systems considering human factors

REFERENCES

CO-PO MAPPING

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

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

IL4074 HUMAN FACTORS IN ENGINEERING L T P C
3 0 0 3

OBJECTIVES:
- Studying the work procedure and understanding the relationships between the workers and working environments.
- To study the applications of ergonomic principles and physiology of workers.
- To know the concepts of personal protective equipment and its usages.
- To create the knowledge in process and equipment design in safety aspects.

UNIT I ERGONOMICS AND ANATOMY 9
Introduction to ergonomics: The focus of ergonomics, ergonomics and its areas of application in the work system, a brief history of ergonomics, attempts to humanize work, modern ergonomics, future directions for ergonomics
Anatomy, Posture and Body Mechanics: Some basic body mechanics, anatomy of the spine and pelvis related to posture, posture stability and posture adaptation, low back pain, risk factors for musculoskeletal disorders in the workplace, behavioural aspects of posture, effectiveness and cost effectiveness, research directions
UNIT II    HUMAN BEHAVIOR
Individual differences, Factors contributing to personality, Fitting the man to the job, Influence of
difference on safety, Method of measuring characteristics, Accident Proneness. Motivation,
Complexity of Motivation, Job satisfaction. Management theories of motivation, Job enrichment
theory. Frustration and Conflicts, Reaction to frustration, Emotion and Frustration. Attitudes-
Determination of attitudes, Changing attitudes Learning, Principles of Learning, Forgetting,
Motivational requirements.

UNIT III  ANTHROPOMETRY AND WORK DESIGN FOR STANDING AND
SEATED WORKS
Designing for a population of users, percentile, sources of human variability, anthropometry and its
uses in ergonomics, principals of applied anthropometry in ergonomics, application of anthropometry
in design, design for everyone, anthropometry and personal space, effectiveness and cost
effectiveness
Fundamental aspects of standing and sitting, an ergonomics approach to work station design, design
for standing workers, design for seated workers, work surface design, visual display units, guidelines
for design of static work, effectiveness and cost effectiveness, research directions

UNIT IV    MAN - MACHINE SYSTEM AND REPETITIVE WORKS AND
MANUAL HANDLING TASK
Applications of human factors engineering, man as a sensor, man as information processor, man as
controller – Man vs Machine.
Ergonomics interventions in Repetitive works, handle design, key board design- measures for
preventing in work related musculoskeletal disorders (WMSDs), reduction and controlling, training
Anatomy and biomechanics of manual handling, prevention of manual handling injuries in the work
place, design of manual handling tasks, carrying, postural stability

UNIT V    HUMAN SKILL AND PERFORMANCE AND DISPLAY,
CONTROLS AND VIRTUAL ENVIRONMENTS
A general information-processing model of the users, cognitive system, problem solving,
effectiveness.
Principles for the design of visual displays- auditory displays- design of controls- combining displays
and controls- virtual (synthetic) environments, research issues.

TOTAL: 45 PERIODS

OUTCOMES:
- Students can have the knowledge in work procedure and applications in hazardous workplaces.
- Students can design their own safety devices and equipment to reduce the accidents
  possibilities.
- Students will be able to incorporate human factors in design of Personal protective equipment.
- They know the risk factors, guide lines for safe design of man machine systems considering
  human factors.

REFERENCES
4. The Ergonomics manual, Dan Mc Leod, Philip Jacobs and Nancy Larson
CO-PO MAPPING

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

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

IS4002 MAINTAINABILITY ENGINEERING

OBJECTIVES:
- To enable the students know about the basic concept of maintainability engineering.
- To impart knowledge on various maintenance models, maintenance policies and replacement model of various equipment.
- To provide knowledge on logistics for the effective utilization of existing resources and facilities availability of spares parts.

UNIT I MAINTENANCE CONCEPT

UNIT II MAINTENANCE MODELS

UNIT III MAINTENANCE LOGISTICS

UNIT IV MAINTENANCE QUALITY

UNIT V TOTAL PRODUCTIVE MAINTENANCE
TPM features – Chronic and sporadic losses – Equipment defects – Six major losses – Overall Equipment Effectiveness – TPM pillars – Autonomous maintenance – TPM implementation

TOTAL: 45 PERIODS
OUTCOMES:
The students will be able to
1. Understand the various terms and terminologies about the maintenance concept.
2. Understand the various maintenance modes and logistics meant for the execution of various services.
3. Apply their knowledge in areas where the down time, over replacement are existing and could lead to improve the productivity and quality.

REFERENCES

CO-PO MAPPING

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

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

IS4003  OPTIMIZATION TECHNIQUES  L T P C
COURSE OBJECTIVES:
• To understand the non-linear problem.
• To know about multi-objective problem.
• To create awareness of Meta heuristic algorithms.

UNIT I  INTRODUCTION
Classification of optimization problems, concepts of design vector, Design constraints, constrains surface, objective function surface and multi-level optimization, parametric linear programming

UNIT II  DECISION ANALYSIS
Decision Trees, Utility theory, Game theory, Multi Objective Optimization, MCDM- Goal Programming, Analytic Hierarchy process, ANP

UNIT III  NON-LINEAR OPTIMIZATION
Unconstrained one variable and multi variable optimization, KKT Conditions, Constrained optimization, Quadratic programming, Convex programming, Separable programming, Geometric programming, Non-Convex programming

UNIT IV  NON-TRADITIONAL OPTIMIZATION -1
Classes P and NP, Polynomial time reductions, Introduction to NP- Hard problems, Overview of Genetic algorithms, Simulated Annealing, neural network based optimization.
UNIT V  NON-TRADITIONAL OPTIMIZATION -2
Particle Swarm optimization, Ant Colony Optimization, Optimization of Fuzzy Systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
• The students will gain familiarity with some of the well-known optimization techniques and their applicability in a real setting.
• The students will gain awareness on the usefulness and limitation of optimization.

REFERENCES

IS4004  TRANSPORT SAFETY
OBJECTIVES:
• To provide the students about the various activities/steps to be followed in safe handling the hazardous goods transportation from one location to another location.
• To educate the reasons for the road accident and the roles and responsibilities of a safe Driver and the training needs of the driver.
• To inculcate the culture of safe driving and fuel conservation along with knowing of basic traffic symbols followed throughout the highways.

UNIT I  TRANSPORTATION OF HAZARDOUS GOODS
Transport emergency card (TREM) – driver training-parking of tankers on the highways-speed of the vehicle – warning symbols – design of the tanker lorries -static electricity-responsibilities of driver – inspection and maintenance of vehicles-check list- loading and decanting procedures – communication.

UNIT II  ROAD TRANSPORT

UNIT III  DRIVER AND SAFETY
UNIT IV  ROAD SAFETY

Road alignment and gradient-reconnaissance-ruling gradient-maximum rise per k.m.- factors influencing alignment like tractive resistance, tractive force, direct alignment, vertical curves-breaking characteristics of vehicle-skidding-restriction of speeds-significance of speeds- Pavement conditions – Sight distance – Safety at intersections – Traffic control lines and guide posts-guard rails and barriers – street lighting and illumination overloading-concentration of driver.

Plant railway: Clearance-track-warning methods-loading and unloading-moving cars-safety practices.

UNIT V  SHOP FLOOR AND REPAIR SHOP SAFETY

Transport precautions-safety on manual, mechanical handling equipment operations-safe driving-movement of cranes-conveyors etc., servicing and maintenance equipment-grease rack operation-wash rack operation-battery charging-gasoline handling-other safe practices-off the road motorized equipment.

OUTCOMES:
The students will be able to
1. Recognize various safety activities undertaken in transporting of hazardous goods
2. Understand the various symbols which are specific to the road safety and able to reduce the accidents occurred in the roads.
3. Apply for the safe transportation of hazardous goods, creating TREM card and safe loading and unloading procedure.

REFERENCES:
3. K.W.Ogden, “Safer Roads – A guide to Road Safety Engineering”

CO-PO MAPPING

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

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

IS4005  FIREWORKS SAFETY

OBJECTIVES:
- To study the properties of pyrotechnic chemicals
- To know about the hazards in the manufacture of various fireworks
- To understand the hazards in fireworks industries related processes
- To study the effects of static electricity
- To learn pyrotechnic material handling, transportation and user safety
UNIT I    PROPERTIES OF FIREWORKS CHEMICALS
Fire properties – potassium nitrate (KN03), potassium chlorate (KClO3), barium nitrate (BaNO3),
calcium nitrate (CaNO3), Sulphur (S), Phosphorous (P), antimony (Sb), Pyro Aluminum (A1) powder-
Reactions-metal powders, Borax, ammonia (NH3) – Strontium Nitrate, Sodium Nitrate, Potassium per
chloride. Fire and explosion, impact and friction sensitivity.

UNIT II    STATIC CHARGE AND DUST
Concept-prevention-earthing-copper plates-dress materials-static charge meter lightning, Causes-
effects-hazards in fireworks factories-lightning arrester :concept-installation-earth pit-maintenance-
resistance-legal requirements-case studies.

Dust: size-desirable, non-respirable-biologicalbarriers-hazards-personal protective equipment-
pollution prevention.

UNIT III    PROCESS SAFETY
Safe-quantity, mixing-filling-fuse cutting – fuse fixing – finishing – drying at various stages-packing-
storage-hand tools-materials, layout: building-distances- factories act – explosive act and rules – fire
prevention and control – risk related fireworks industries.

UNIT IV    MATERIAL HANDLING AND TRANSPORTATION:
handling-nitric acid handling in snake eggs manufacture-handling the mix in this factory-material
movement-godown-waste pit.
Packing-magazine-design of vehicles for explosive transports loading into automobiles-transport
restrictions-case studies-overhead power lines-driver habits-intermediate parking-fire extinguishers-
loose chemicals handling and transport.

UNIT V    WASTE CONTROL AND USER SAFETY
Concepts of wastes – Wastes in fireworks-Disposal-Spillages-storage of residues. Consumer anxiety-
hazards in display-methods in other countries-fires, burns and scalds-sales outlets-restrictions-role of
fire service.

OUTCOMES:
Upon completion of the course the students will be able
- To gain knowledge of the chemical reactions of Fireworks chemicals
- To know safe manufacture of Fireworks items
- To improve process safety in fireworks industries
- To analyse safety measures applicable against static electricity
- To suggest safe practices for handling of fireworks in factories, transport and at user end

REFERENCES:
1. “Seminar on explosives”, Dept.of of explosives.
2. J.A.Purkiss, “Fireworks-Fire Safety Engineering”
5. A.Chelladurai, “Fireworks related accidents”
6. A.Chelladurai, “Fireworks principles and practice”
7. A.Chelladurai, “History of the fireworks in India” Brock, “History of fireworks”
**CO-PO MAPPING**

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

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

**IS4006 SAFETY IN CONSTRUCTION**

**OBJECTIVES:**
- To know causes of accidents related to construction activities and human factors associated with these accidents
- To understand the construction regulations and quality assurance in construction
- To have the knowledge in hazards of construction and their prevention methods
- To know the working principles of various construction machinery
- To gain knowledge in health hazards and safety in demolition work

**UNIT I ACCIDENTS CAUSES AND MANAGEMENT SYSTEMS**

Problems impeding safety in construction industry- causes of fatal accidents, types and causes of accidents related to various construction activities, human factors associated with these accidents – construction regulations, contractual clauses – Pre contract activates, preconstruction meeting - design aids for safe construction – permits to work – quality assurance in construction - compensation – Recording of accidents and safety measures – Education and training

**UNIT II HAZARDS OF CONSTRUCTION AND PREVENTION**


**UNIT III WORKING AT HEIGHTS**

Fall protection in construction OSHA 3146 – OSHA requirement for working at heights, Safe access and egress – safe use of ladders- Scaffoldings, requirement for safe work platforms, stairways, gangways and ramps – fall prevention and fall protection , safety belts, safety nets, fall arrestors, controlled access zones, safety monitoring systems – working on fragile roofs, work permit systems, height pass – accident case studies.

**UNIT IV CONSTRUCTION MACHINERY**

UNIT V SAFETY IN DEMOLITION WORK

Safety in demolition work, manual, mechanical, using explosive - keys to safe demolition, pre survey inspection, method statement, site supervision, safe clearance zone, health hazards from demolition - Indian standard - trusses, girders and beams – first aid – fire hazards and preventing methods – interesting experiences at the construction site against the fire accidents.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course the students will be able
- To identify the problems impeding safety in construction industries.
- To identify types and causes of accidents, and designing aids for safe construction.
- To understand the hazards during construction of power plant, road works and high rise buildings.
- To understand the safety procedure for working at heights during construction.
- To have knowledge in selection, operation, inspection and testing of various construction machinery.
- To list out construction regulations and Indian standards for construction and demolition work.

REFERENCES
1. Handbook of OSHA Construction safety and health charles D. Reese and James V. Edison

CO-PO MAPPING

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AVg.</td>
<td>2/1=2</td>
<td>3/1=3</td>
<td>2/1=2</td>
<td>(3+2)/2=2.5</td>
<td>2/1=2</td>
<td>2/1=2</td>
</tr>
</tbody>
</table>

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

IS4007 NUCLEAR ENGINEERING AND SAFETY L T P C 3 0 0 3

OBJECTIVES:
- To know about nuclear energy and fission fusion process.
- To gain knowledge in reactor types, design considerations and their operational problems.
- To know the current status of India in nuclear energy.

UNIT I INTRODUCTION
UNIT II  REACTOR CONTROL  9
Control requirements in design considerations – means of control – control and shut down rods – their operation and operational problems – control rod worth – control instrumentation and monitoring – online central data processing system.

UNIT III  REACTOR TYPES  9
Boiling water reactors – radioactivity of steam system – direct cycle and dual cycle power plants- pressurized water reactors and pressurized heavy water reactors – fast breeder reactors and their role in power generation in the Indian context – conversion and breeding – doubling time – liquid metal coolants – nuclear power plants in India.

UNIT IV  SAFETY OF NUCLEAR REACTORS  9

UNIT V  RADIATION CONTROL  9

TOTAL: 45 PERIODS

OUTCOMES:
The students will be able to
1. Demonstrate nuclear fission and fusion process and their utilization.
2. Understand types of reactors and their Control requirements.
3. Explain the safety design principles and safety regulation process.

REFERENCES

CO-PO MAPPING

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

1- low, 2-medium, 3-high, ‘-‘- no correlation
OBJECTIVES:
- To provide the student about the basic knowledge about the textile industries and its products by using various machineries.
- To enforce the knowledge on textile processing and various processes in making the yarn from cotton or synthetic fibres.
- To understand the various hazards of processing textile fibres by using various activities.
- To inculcate the knowledge on health and welfare activities specific to the Textile industries as per the Factories Act.

UNIT I
INTRODUCTION
Introduction to process flow charts of i) short staple spinning, ii) long staple spinning, iii) viscose rayon and synthetic fibre, manufacturer, iv) spun and filament yarn to fabric manufacture, v) jute spinning and jute fabric manufacture-accident hazard, guarding of machinery and safety precautions in opening, carding, combing, drawing, flyer frames and ring frames, doubles, rotor spinning, winding, warping, softening/spinning specific to jute.

UNIT II
TEXTILE HAZARDS I
Accident hazards i) sizing processes- cooking vessels, transports of size, hazards due to steam ii) Loom shed – shuttle looms and shuttless looms iii) knitting machines iv) non-wovens.

UNIT III
TEXTILE HAZARDS II
Scouring, bleaching, dyeing, punting, mechanical finishing operations and effluents in textile processes.

UNIT IV
HEALTH AND WELFARE
Health hazards in textile industry related to dust, fly and noise generated-control measures-relevant occupational diseases, personal protective equipment-health and welfare measures specific to textile industry. Special precautions for specific hazardous work environments.

UNIT V
SAFETY STATUS
Relevant provision of factories act and rules and other statues applicable to textile industry – effluent treatment and waste disposal in textile industry.

TOTAL: 45 PERIODS

OUTCOMES:
- The student will able to know about the overall picture about the textile industries and its operations.
- The student could understand the various concepts underlying in the processes involved in processing of fibres to yarn.
- The student will be able to find out various hazards in the textile industry and will be able to apply the control measures to mitigate the risk emanating from the hazard.
- The student could have the capability to handle the various health and welfare activities as per the Factories act and could implement statutory requirements.
- The student could create of his own arrangement in designing various methods meant for mitigating the risk and able to guide his subordinates in executing the work safely.
REFERENCES:
1. 100 Textile fires – analysis, findings and recommendations LPA
2. Groover and Henry DS, “Hand book of textile testing and quality control”
3. “Quality tolerances for water for textile industry”, BIS
5. Little, A.H.,“Water supplies and the treatment and disposal of effluent”

CO-PO MAPPING

<table>
<thead>
<tr>
<th>CO</th>
<th>PO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AVg.</td>
<td></td>
<td></td>
<td></td>
<td>2/1=2</td>
<td>(3+2)/2=2.5</td>
<td>(2+2)/2=2</td>
<td>2/1=2</td>
</tr>
</tbody>
</table>

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

IS4009

SAFETY IN MINES

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

OBJECTIVES:
- To provide in depth knowledge on Safety of mines of various types.
- To study, know and understand about the types of mines and various risk involved in the mining operations.
- To get exposed to various types of accidents happened in mines and how to manage during accidents.
- To analyse the nature of mining activities and developing a safety system to reduce the risk and also to implement the Emergency preparedness in the working environment of mines and to plan for the disaster management.

UNIT I

OPENCAST MINES

UNIT II

UNDERGROUND MINES
Fall of roof and sides-effect of gases-fire and explosions-water flooding-warning sensors-gas detectors-occupational hazards-working conditions-winding and transportation.

UNIT III

TUNNELLING
UNIT IV    RISK ASSESSMENT  

UNIT V    ACCIDENT ANALYSIS AND MANAGEMENT  

TOTAL: 45 PERIODS

OUTCOMES:
- This course would make the student familiar with the concept of safety aspects in the mining industries.
- Course would be helpful in understanding the various types of mining activities like open case mines, underground mines and tunnel ling.
- The students will understand about the various risks involved in the mining activities and come to know about the various safety activities to be taken to ensure the safety of the workers.
- Students could able to implement the techniques like risk assessment Disaster management and emergency preparedness with the proper knowledge on accident prevention.
- Course would equip the students to effectively employ their knowledge on accident prevention in mines.

REFERENCES:

CO-PO MAPPING

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AVg.</td>
<td>-</td>
<td>(3+2)/2=2.5</td>
<td>3/1=3</td>
<td>-</td>
<td>2/1=2</td>
<td>3/1=3</td>
</tr>
</tbody>
</table>

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

IS4010    DOCK SAFETY

OBJECTIVES:
- To understand safety legislation related to dock activities in India.
- To understand the causes and effects of accidents during dock activities.
- To know the various material handling equipment and lifting appliances in dock.
- To know the safe working on board the ship and storage in the yards.
- To understand the safe operation of crane, portainers, lift trucks and container handling equipment.
UNIT I  HISTORY OF SAFETY LEGISLATION
History of dock safety statues in India-background of present dock safety statues- dock workers (safety, health and welfare) act 1986 and the rules and regulations framed there under, other statues like marking of heavy packages act 1951 and the rules framed there under - manufacture, storage and import of hazardous chemicals. Rules 1989 framed under the environment (protection) act, 1989 – few cases laws to interpret the terms used in the dock safety statues.

UNIT II  WORKING ON BOARD THE SHIP
Types of cargo ships – working on board ships – Safety in handling of hatch beams – hatch covers including its marking, Mechanical operated hatch covers of different types and its safety features – safety in chipping and painting operations on board ships – safe means of accesses – safety in storage etc. – illumination of decks and in holds – hazards in working inside the hold of the ship and on decks – safety precautions needed – safety in use of transport equipment - internal combustible engines like fort-lift trucks-pay loaders etc. Working with electricity and electrical management – Storage – types, hazardous cargo.

UNIT III  LIFTING APPLIANCES
Different types of lifting appliances – construction, maintenance and use, various methods of rigging of derricks, safety in the use of container handling/lifting appliances like portainers, transtainer, top lift trucks and other containers – testing and examination of lifting appliances – portainers – transtainers – toplift trucks – derricks in different rigging etc.
Use and care of synthetic and natural fiber ropes – wire rope chains, different types of slings and loose gears.

UNIT IV  TRANSPORT EQUIPMENT
The different types of equipment for transporting containers and safety in their use-safety in the use of self loading container vehicles, container side lifter, fork lift truck, dock railways, conveyors and cranes.
Safe use of special lift trucks inside containers – Testing, examination and inspection of containers – carriage of dangerous goods in containers and maintenance and certification of containers for safe operation
Handling of different types of cargo – stacking and unstacking both on board the ship and ashore – loading and unloading of cargo identification of berths/walking for transfer operation of specific chemical from ship to shore and vice versa – restriction of loading and unloading operations.

UNIT V  EMERGENCY ACTION PLAN AND DOCK WORKERS (SHW) REGULATIONS 1990
Emergency action Plans for fire and explosions - collapse of lifting appliances and buildings, sheds etc., - gas leakages and precautions concerning spillage of dangerous goods etc., - Preparation of on-site emergency plan and safety report.
Dock workers (SHW) rules and regulations 1990-related to lifting appliances, Container handling, loading and unloading, handling of hatch coverings and beams, Cargo handling, conveyors, dock railways, forklift.

TOTAL: 45 PERIODS
OUTCOMES:
- This course would make the student to familiar of various operations carried out in a dock.
- Students would know the different acts and rules for safe dock operations.
- Students could be able to understand the operation of various types of material handling equipments.
- Students would be prepared to response at the time of emergency in a dock.
- Students can recognize the various problems associated with the use of lifting equipments and in the storage yards.

REFERENCES
2. Bindra SR “Course in Dock and Harbour Engineering”
4. Srinivasan “Harbour, Dock and Tunnel Engineering”

CO-PO MAPPING

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

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

IS4011 SAFETY IN ENGINEERING INDUSTRY L T P C 3 0 0 3

OBJECTIVES:
- To know the safety rules and regulations, standards and codes.
- To study various mechanical machines and their safety importance.
- To understand the principles of machine guarding and operation of protective devices.
- To know the working principle of mechanical engineering processes such as metal forming and joining process and their safety risks.
- Developing the knowledge related to health and welfare measures in engineering industry.

UNIT I SAFETY IN METAL WORKING MACHINERY AND WOOD WORKING MACHINES 9
General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines,

Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards.
UNIT II  PRINCIPLES OF MACHINE GUARDING
Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing-guard construction-guard opening.

UNIT III  SAFETY IN WELDING AND GAS CUTTING
Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases-colour coding – flashback arrestor – leak detection-pipe line safety-storage and handling of gas cylinders.

UNIT IV  SAFETY IN COLD FARMING AND HOT WORKING OF METALS
Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls, power press set up and die removal, inspection and maintenance-metal sheers-press brakes.
Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills – hot bending of pipes, hazards and control measures.
Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, foundry production cleaning and finishing foundry processes.

UNIT V  SAFETY IN FINISHING, INSPECTION AND TESTING
Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation.
Health and welfare measures in engineering industry-pollution control in engineering industry-industrial waste disposal.

OUTCOMES:
- Students can have the knowledge in safety rules, standards and codes in various mechanical engineering processes
- They can design machine guarding systems for various machines such as lathe, drilling, boring, milling etc.,
- They can implement the safety concepts in welding, gas cutting, storage and handling of gas cylinders, metal forming processes etc.,
- Students will have knowledge in testing and inspection as per rules in boilers, heat treatment operations etc.,
- They can take preventive measures in health and welfare of workers’ aspects in engineering industry.
REFERENCES
5. Indian Boiler acts and Regulations, Government of India.

CO-PO MAPPING:

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>Avg.</td>
<td>-</td>
<td>(3+3)/2=3</td>
<td>-</td>
<td>3/1=3</td>
<td>(3+2)/2=2.5</td>
<td>(3+3)/2=3</td>
</tr>
</tbody>
</table>

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

IS4012 QUALITY ENGINEERING IN PRODUCTION SYSTEMS L T P C 3 0 0 3

OBJECTIVES:
- To know the quality engineering concepts in product design and development processes.
- To know the control and process parameters’ characteristics with feedback system.
- To know the methods for production and diagnosis process improvements.
- To have knowledge on ISO quality systems and types of quality tools such as failure and effect analysis.
- To understand the six-sigma concepts and its implementation in engineering industries.

UNIT I INTRODUCTION TO QUALITY ENGINEERING AND LOSS FUNCTION 9

UNIT II ON-LINE QUALITY CONTROL 9
On-line feedback quality control variable characteristics-control with measurement interval- one unit, multiple units-control systems for lot and batch production. On-line process parameter control variable characteristics- process parameter tolerances- feedback control systems-measurement error and process control parameters.
UNIT III ON-LINE QUALITY CONTROL ATTRIBUTES AND METHODS FOR PROCESS IMPROVEMENTS 9
Checking intervals- frequency of process diagnosis. Production process improvement method-process diagnosis improvement method-process adjustment and recovery improvement methods.

UNIT IV QUALITY ENGINEERING AND TPM 9
Preventive maintenance schedules-PM schedules for functional characteristics-PM schedules for large scale systems. Quality tools-fault tree analysis, event tree analysis, failure mode and effect analysis. ISO quality systems.

UNIT V SIX SIGMA AND ITS IMPLEMENTATION 9
Introduction-definition-methodology-impact of implementation of six sigma-DMAIC method-roles and responsibilities-leaders, champion, black belt, green belts. Do’s and don’ts-readiness of organization-planning-management role-six sigma tools-sustaining six sigma.

TOTAL: 45 PERIODS

OUTCOMES:
1. Students can understand the loss function derivation and quality engineering in product design and development processes.
2. Students can develop their knowledge in online quality control systems and process control parameters.
3. The students will be able to improve the production and process diagnosis and production process.
4. The students will be able to gain knowledge in ISO quality management systems.
5. The students will be able to list the roles and responsibilities of leaders.

REFERENCES:

CO-PO MAPPING

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AVg.</td>
<td>(3+2)/2=2.5</td>
<td>(3+2)/2=2.5</td>
<td>(2+3)/2=2.5</td>
<td>3/1=3</td>
<td>3/1=3</td>
<td>-</td>
</tr>
</tbody>
</table>

1- low, 2-medium, 3-high, ‘-‘-no correlation
OBJECTIVES:
- The course could provide the basic knowledge on Occupational Health and Safety Management System and Environmental Management System standards.
- To inculcate the knowledge on various terms and terminologies which are used in the Occupational Health, Safety and Environmental Management system.
- To educate about the various steps to be taken for certification of ISO 45001 (Occupational health and safety management systems) and ISO14001 (Environmental Management Systems) standards.
- To impart knowledge on Environment Impact Assessment (EIA), Life Cycle Assessment of product and principles of Eco labelling.

UNIT I  OH & S MANAGEMENT SYSTEM STANDARD  9

UNIT II  PLANNING  9

UNIT III  PERFORMANCE EVALUATION  9

UNIT IV  ISO 14001 & ISO 19011  9
EMS, ISO 14001, specifications, objectives, Environmental Policy, Guidelines and Principles (ISO 14004), clauses 4.1 to 4.5. Documentation requirements, 3 levels of documentation for a ISO 14000 based EMS, steps in ISO 14001.
Implementation plan, Registration, Importance of ISO 14000 to the Management. Auditing ISO14000- General principles of Environmental Audit, Auditor, steps in audit, Audit plan.
ISO 19011- Guidelines for auditing management Systems-General principles, managing audit programme- audit activities, steps in audit, audit plan-competence of auditors.

UNIT V  ENVIRONMENT IMPACT ASSESSMENT  9
ISO 14040(LCA), General principles of LCA, Stages of LCA, Report and Review. ISO 14020 (Eco labeling) – History, 14021, 14024, Type I labels, Type II labels, ISO 14024, principles, rules for eco labeling before company attempts for it. Advantages. EIA in EMS, Types of EIA, EIA methodology EIS, Scope, Benefits.

Audit-methodology, Auditors Audit results management review-Continual improvement.

TOTAL: 45 PERIODS
OUTCOMES:

- The student would be able to remember the various standards which is meant mainly for maintaining the Health of the employee and for the maintenance of the Environment.
- The student could be able to understand the basic difference between the ISO 9000 series and ISO 45001 and ISO 14000 standards and the various clauses which governs the system in maintaining the standard.
- The course could provide the sufficient knowledge on various clauses and subsequent preparation of procedures and related documents and could be able to apply their knowledge in preparing the ISO manual for getting the certification from the external certifying agencies.
- Course could help the students in acquiring the knowledge on various standards and provide the skill in analysing the various clauses and its suitability and applicability on the nature of organization.

REFERENCES:

1. ISO 45001: 2018 –Occupational Health and safety management systems
   Requirements with guidance for use

CO-PO MAPPING

<table>
<thead>
<tr>
<th>CO</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>-</td>
<td>3</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>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AVg.</td>
<td>-</td>
<td>(3+3)/2=3</td>
<td>(2+3)/2=2.5</td>
<td>3/1=3</td>
<td>2/1=2</td>
<td>2/1=2</td>
</tr>
</tbody>
</table>

1- low, 2-medium, 3-high, ‘-‘-no correlation
OBJECTIVES:
- To know the fundamental concepts and applications of Artificial intelligence.
- To familiarize with AI languages like PROLOG and LISP.
- To understand the various features of expert system.
- To have knowledge about Neural Network and corresponding selection of parameters.

UNIT I INTRODUCTION
Intelligence – Definition, types cognitive aspect approach, measuring intelligence – early efforts, IQ and AI: aspects of intelligence – learning, problem solving, creativity, behaviour and biology. Artificial intelligence: Historical background, applications of AI, objections and myths, AI languages: Introduction to PROLOG and LISP.

UNIT II COGNITIVE PSYCHOLOGY
The mind – informative and cybernetics, components for thought, modes of perception – visual, auditory and other systems: memory mechanisms, problem solving – planning, search, the GPS systems; types of learning – rote, parameter, method and concept: Game playing, reasoning, Artificial Vision – picture processing – identifying real objects; Vision programs, factory vision systems.

UNIT III KNOWLEDGE ENGINEERING
Introduction – role of knowledge engineer, knowledge representation – psychology, production rules, logic and programming, Common sense and fuzzy logic, semantic networks, learning systems.

UNIT IV EXPERT SYSTEMS

UNIT V INTRODUCTION TO NEURAL NETWORKS

OUTCOMES:
- To apply various aspects of intelligence to diverse industrial situations.
- To list out the applications of expert system.
- To develop a simple expert system related to industrial safety Engineering.
- To apply neural network concepts in safety engineering discipline.

REFERENCES:
CO-PO MAPPING

| CO | PO
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>-</td>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>5</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>AVg.</td>
<td>(3+3)/2=3</td>
<td>(3+2)/2=2.5</td>
<td>(2+3)/2=2.5</td>
<td>-</td>
<td>-</td>
<td>3/1=3</td>
</tr>
</tbody>
</table>

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

IL4091  
DESIGN OF EXPERIMENTS

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

UNIT I  
EXPERIMENTAL DESIGN FUNDAMENTALS
Importance of experiments, experimental strategies, basic principles of design, terminology, ANOVA, steps in experimentation, sample size, normal probability plot, linear regression models.

UNIT II  
SINGLE FACTOR EXPERIMENTS
Completely randomized design, Randomized block design, Latin square design. Statistical analysis, estimation of model parameters, model adequacy checking, pair wise comparison tests.

UNIT III  
MULTIFACTOR EXPERIMENTS
Two and three factor full factorial experiments, Randomized block factorial design, Experiments with random factors, rules for expected mean squares, approximate F-tests. $2^K$ factorial Experiments.

UNIT IV  
SPECIAL EXPERIMENTAL DESIGNS:
Blocking and confounding in $2^K$ designs. Two level Fractional factorial design, nested designs, Split plot design, Introduction to Response Surface Methods.

UNIT V  
TAGUCHI METHODS
Steps in experimentation, design using Orthogonal Arrays, data analysis, Robust design- control and noise factors, S/N ratios, parameter design, Multi-level experiments, Multi-response optimization, Introduction to Shainin DOE.

TOTAL: 45 PERIODS
OUTCOMES:
CO1: Understand the fundamental principles of Design of Experiments.
CO2: Analyze data in the single factor experiments.
CO3: Analyze data in the multifactor experiments.
CO4: Understand the special experimental designs & Response Surface Methods.
CO5: Apply Taguchi based approach to evaluate quality.

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>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg.</td>
<td>(1+2)/2=1,5</td>
<td>(1+1)/2=1</td>
<td>(1+1+1+1)/4=1</td>
<td>(1+1+1)/3=1</td>
<td>1/1=1</td>
<td></td>
</tr>
</tbody>
</table>

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

IS4071 DATA ANALYTICS

COURSE OBJECTIVES:
1. Recognize the importance of data analytics
2. Exhibit competence on data analytics packages
3. Apply solution methodologies for industrial problems.

UNIT I INTRODUCTION

UNIT II MULTIPLE REGRESSION
Multiple Regression- Linear and Nonlinear techniques- Backward-Forward-Stepwise Hierarchical regression-Testing interactions (2way interaction) - Analysis of Variance and Covariance (ANOVA & ANCOVA) - Multivariate Analysis of Variance and Covariance (MANOVA & MANCOVA).
UNIT III LOGISTIC REGRESSION
Regression with binary dependent variable - Simple Discriminant Analysis Multiple Discriminant analysis-Assessing classification accuracy- Conjoint analysis (Full profile method).

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

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

TOTAL: 45 PERIODS

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

- To recognize the importance of data analytics
- To Exhibit competence on data analytics packages
- To apply solution methodologies for industrial problems.

REFERENCES:

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

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

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

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

UNIT II   PRESENTATION SKILLS

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

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

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

TOTAL: 30 PERIODS

COURSE OUTCOMES

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

REFERENCES

AX4092  DISASTER MANAGEMENT  L  T  P  C  2 0 0 0

OBJECTIVES

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

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

UNIT II  REPERCUSSIONS OF DISASTERS AND HAZARDS  6

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

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

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

TOTAL : 30 PERIODS

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

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

OBJECTIVES
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional Role and entitlement to civil and economic rights as well as the emergence 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
- The Constitution of India, 1950 (Bare Act), Government Publication.
- பார்வி பலன்பலவக்குக் கோட்ட எகாதிக்கது, வாக்கு பெரியக்கு பர்வதங்

2. தமிழிலிருந்து
- அண்டகண்ட பன்னாட்டு விளையாடு
3. திசையந்தியம் (617, 618)
- பீலம் பீலம் விளிம்பு
4. தமிழ்நாடு தொலைக்காட்சியகம் நேரிலிவே இணைப்பு
5. புறநொந்து
- நேரிலிவே தொலைப்பக்கங்கள்
6. அன்னுமில் (4) - எகாதிக்க
   கோட்டுக் கோட்டம் (11) - எகாதிக்க
   கோட்டுக்கள் (11) - பார்வி, பார்வி
   பார்வி 50 (27) - பார்வி
   புறநொந்து பூர்வ விளிம்பு

UNIT V தவறு தொட்டு தவறுகள்

1. தமிழ் இக்கண்ணைக்குக் கோட்ட, -
   தமிழ் புரோதி பூர்வ, -
   தமிழ் புரோதி தொழில்கள்,
   தமிழ் தவறுகள்,
   பார்வி தவறுகள்,
   தமிழ்
2. தமிழ் பொன்னு வார்த்தை பொன்னு தவறு தவறுகள்,
3. தமிழ் பொன்னு வார்த்தை பொன்னு தவறு தவறுகள்,
4. தமிழ் பொன்னு வார்த்தை பொன்னு விளிம்பு பொன்னு தவறு தவறுகள்,
5. தமிழ் தவறு தவறு,
6. தமிழ் தவறு தவறு,
7. தமிழ் தவறு தவறு

TOTAL: 30 PERIODS

தமிழ் தவறுகள் வணிகப்படுத்தல் / பட்க்காட்சிகள்

1. தகுர் தொலைப்பக கண்முனைக்குகாலம் (Tamil Virtual University) - www.tamilvu.org
2. தமிழ் விக்கிப்பீடிப்பளவு (Tamil Wikipedia) -https://ta.wikipedia.org
3. தஞ்சாவு தொகுப்பியின்
4. தமிழ் வினையோக கண்காட்சிப் பல்கலைக்கழகம் - தமிழ் வினையோக கண்காட்சிப் பல்கலைக்கழகம், தகுர்
5. தமிழ் தொலையோக கண்காட்சிப் பல்கலைக்கழகம் - தமிழ் தொலையோக கண்காட்சிப் பல்கலைக்கழகம் (thamilvalarchithurai.com)
6. தமிழ் தொலையோக கண்காட்சிப் பல்கலைக்கழகம் - தமிழ் தொலையோக கண்காட்சிப் பல்கலைக்கழகம், தகுர்
OBJECTIVE
• Students will be introduced to the concepts and principles of IWRM, which is inclusive of the economics, public-private partnership, water & health, water & food security and legal & regulatory settings.

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

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

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

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

UNIT V AGRICULTURE IN THE CONCEPT OF IWRM

TOTAL: 45 PERIODS

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

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

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></td>
<td>1</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></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></td>
<td></td>
</tr>
</tbody>
</table>
OBJECTIVES:

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

UNIT I FUNDAMENTALS WASH

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

UNIT II MANAGERIAL IMPLICATIONS AND IMPACT


UNIT III CHALLENGES IN MANAGEMENT AND DEVELOPMENT


UNIT IV GOVERNANCE

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

UNIT V INITIATIVES

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

TOTAL: 45 PERIODS

OUTCOMES:

| CO1 | Capture to fundamental concepts and terms which are to be applied and understood all through the study. |
| CO2 | Comprehend the various factors affecting water sanitation and health through the lens of third world scenario. |
| CO3 | Critically analyse and articulate the underlying common challenges in water, sanitation and health. |
| CO4 | Acquire knowledge on the attributes of governance and its say on water sanitation and health. |
| CO5 | Gain an overarching insight in to the aspects of sustainable resource management in the absence of a clear level playing field in the developmental aspects. |
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 CO1 CO2 CO3 CO4 CO5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>Knowledge of Engineering Sciences</td>
<td>1 1 M 1</td>
</tr>
<tr>
<td>PO2</td>
<td>Problem analysis</td>
<td>2 2 2 2</td>
</tr>
<tr>
<td>PO3</td>
<td>Design / development of solutions</td>
<td>2 1 2</td>
</tr>
<tr>
<td>PO4</td>
<td>Investigation</td>
<td>2 3 3 3</td>
</tr>
<tr>
<td>PO5</td>
<td>Modern Tool Usage</td>
<td>3 1 1</td>
</tr>
<tr>
<td>PO6</td>
<td>Individual and Team work</td>
<td>2 2 1 2</td>
</tr>
<tr>
<td>PO7</td>
<td>Communication</td>
<td>2 2 2</td>
</tr>
<tr>
<td>PO8</td>
<td>Engineer and Society</td>
<td>3 3 3 3</td>
</tr>
<tr>
<td>PO9</td>
<td>Ethics</td>
<td>1 2 2 2</td>
</tr>
<tr>
<td>PO10</td>
<td>Environment and Sustainability</td>
<td>3 3 3</td>
</tr>
<tr>
<td>PO11</td>
<td>Project Management and Finance</td>
<td>3 3 2</td>
</tr>
<tr>
<td>PO12</td>
<td>Life Long Learning</td>
<td>1 1 1</td>
</tr>
<tr>
<td>PSO1</td>
<td>Explain the concepts of water management, field research methodology, gender, legal and environmental aspects in the context of integrated water resources management</td>
<td>3 3 3 3</td>
</tr>
<tr>
<td>PSO2</td>
<td>Formulate, analyse and comprehend the differences in social and economic variability in South Asian context with their peers and strive to work towards sustainability</td>
<td>3 2 3 3</td>
</tr>
<tr>
<td>PSO3</td>
<td>Produce and publish professional reports, peer reviewed journal on contemporary and state of art research in water resources Engineering</td>
<td>3 3 3 2</td>
</tr>
</tbody>
</table>
OBJECTIVES:
- To impart knowledge on environmental, social and economic dimensions of sustainability and the principles evolved through landmark events so as to develop an action mindset for sustainable development.

UNIT I   SUSTAINABILITY AND DEVELOPMENT CHALLENGES  9

UNIT II  PRINCIPLES AND FRAME WORK  9

UNIT III  SUSTAINABLE DEVELOPMENT AND WELLBEING  9

UNIT IV  SUSTAINABLE SOCIO-ECONOMIC SYSTEMS  10

UNIT V  ASSESSING PROGRESS AND WAY FORWARD  8
Growth and Green Economy – National Sustainable Development Strategy Planning and National Status of Sustainable Development Goals

TOTAL: 45 PERIODS

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

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

REFERENCES:

**CO – PO Mapping – Principles of Sustainable Development**

<table>
<thead>
<tr>
<th>PO/PSO</th>
<th>Knowledge of Engineering Sciences</th>
</tr>
</thead>
<tbody>
<tr>
<td>PO1</td>
<td>Knowledge of Engineering Sciences</td>
</tr>
<tr>
<td>PO2</td>
<td>Problem analysis</td>
</tr>
<tr>
<td>PO3</td>
<td>Design / development of solutions</td>
</tr>
<tr>
<td>PO4</td>
<td>Investigation</td>
</tr>
<tr>
<td>PO5</td>
<td>Modern Tool Usage</td>
</tr>
<tr>
<td>PO6</td>
<td>Individual and Team work</td>
</tr>
<tr>
<td>PO7</td>
<td>Communication</td>
</tr>
<tr>
<td>PO8</td>
<td>Engineer and Society</td>
</tr>
<tr>
<td>PO9</td>
<td>Ethics</td>
</tr>
<tr>
<td>PO10</td>
<td>Environment and Sustainability</td>
</tr>
<tr>
<td>PO11</td>
<td>Project Management and Finance</td>
</tr>
<tr>
<td>PO12</td>
<td>Life Long Learning</td>
</tr>
<tr>
<td>PSO1</td>
<td>Knowledge of Environmental Management discipline</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Course Outcome</th>
<th>CO1</th>
<th>CO2</th>
<th>CO3</th>
<th>CO4</th>
<th>CO5</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CO5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall Correlation of POs to COs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></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

UNIT II IMPACT IDENTIFICATION AND PREDICTION

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

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

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

TOTAL: 45 PERIODS

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

| CO1 | Understand need for environmental clearance, its legal procedure, need of EIA, its types, stakeholders and their roles |
| CO2 | Understand various impact identification methodologies, prediction techniques and model of impacts on various environments |
| CO3 | Understand relationship between social impacts and change in community due to development activities and rehabilitation methods |
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>PO1 Knowledge of Engineering Sciences</td>
<td>3 3 3 3</td>
<td></td>
</tr>
<tr>
<td>PO2 Problem analysis</td>
<td>2 2</td>
<td>1</td>
</tr>
<tr>
<td>PO3 Design / development of solutions</td>
<td>3 3 3 3</td>
<td>1</td>
</tr>
<tr>
<td>PO4 Investigation</td>
<td>2 2 2 2</td>
<td></td>
</tr>
<tr>
<td>PO5 Modern Tool Usage</td>
<td>2 2 2 2</td>
<td></td>
</tr>
<tr>
<td>PO6 Individual and Team work</td>
<td>2 2 2 2</td>
<td></td>
</tr>
<tr>
<td>PO7 Communication</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>PO8 Engineer and Society</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>PO9 Ethics</td>
<td>3 3 3 2 2 3</td>
<td></td>
</tr>
<tr>
<td>PO10 Environment and Sustainability</td>
<td>3</td>
<td>2</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>L</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 2 2 2</td>
<td></td>
</tr>
<tr>
<td>PSO3 Conceptualization of Environmental Engineering Systems</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

BLOCKCHAIN TECHNOLOGIES

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  

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

UNIT-IV  INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING  

UNIT V  BLOCKCHAIN APPLICATIONS  
Internet of Things, Medical Record Management System, Domain Name Service and Future of Blockchain, Alt Coins.  TOTAL: 45 PERIODS

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

REFERENCES:

CO-PO Mapping

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg</td>
<td>2.00</td>
<td>1.00</td>
<td>2.50</td>
<td>2.25</td>
<td>2.00</td>
<td>2.00</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:
- Develop and Train Deep Neural Networks.
- Develop a CNN, R-CNN, Fast R-CNN, Faster-R-CNN, Mask-RCNN for detection and recognition
- Build and train RNNs, work with NLP and Word Embeddings
- The internal structure of LSTM and GRU and the differences between them
- The Auto Encoders for Image Processing

UNIT I  DEEP LEARNING CONCEPTS

UNIT II  NEURAL NETWORKS

UNIT III  CONVOLUTIONAL NEURAL NETWORK

UNIT VI  NATURAL LANGUAGE PROCESSING USING RNN

UNIT V  DEEP REINFORCEMENT & UNSUPERVISED LEARNING

COURSE OUTCOMES:
CO1: Feature Extraction from Image and Video Data
CO2: Implement Image Segmentation and Instance Segmentation in Images
CO3: Implement image recognition and image classification using a pretrained network (Transfer Learning)
CO4: Traffic Information analysis using Twitter Data
CO5: Autoencoder for Classification & Feature Extraction
REFERENCES
1. Deep Learning A Practitioner’s Approach Josh Patterson and Adam Gibson O’Reilly Media, Inc.2017
2. Learn Keras for Deep Neural Networks, Jojo Moolayil, Apress,2018
4. Deep Learning with Python, FRANÇOIS CHOLLET, MANNING SHELTER ISLAND,2017

OBA431 SUSTAINABLE MANAGEMENT

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 3

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

UNIT I INTRODUCTION TO SMALL BUSINESS 9

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

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

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

REFERENCES  
3. Journal articles on SME’s.

MAPPING OF POs AND COs

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

OBA433  
INTELLECTUAL PROPERTY RIGHTS

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

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

UNIT III   STATUTES

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

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

TOTAL: 45 PERIODS

COURSE OUTCOMES

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

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

MAPPING OFPOs AND COs

<table>
<thead>
<tr>
<th></th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

75
COURSE OBJECTIVE
➢ To help students develop knowledge and competence in ethical management and decision making in organizational contexts.

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

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

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

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

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

TOTAL: 45 PERIODS

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

REFERENCES

MAPPING OF POs AND COs

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

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

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

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


UNIT 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 9
Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability.
Embedded processors for IOT: Introduction to Python programming - Building IOT with RASPBERRY PI and Arduino.

UNIT V CASE STUDIES 9
Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense

TOTAL: 45 PERIODS

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

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

REFERENCES:
ET4072  MACHINE LEARNING AND DEEP LEARNING  L T P C
3 0 0 3

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

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

UNIT II  NEURAL NETWORKS

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

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

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

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

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

REFERENCES:

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

80

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>
</tbody>
</table>
PS4093 SMART GRID

COURSE OBJECTIVES
- To Study about Smart Grid technologies, different smart meters and advanced metering infrastructure.
- To know about the function of smart grid.
- To familiarize the power quality management issues in Smart Grid.
- To familiarize the high performance computing for Smart Grid applications
- To get familiarized with the communication networks for Smart Grid applications

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

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

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

UNIT IV POWER QUALITY MANAGEMENT IN SMART GRID

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

TOTAL : 45 PERIODS
COURSE OUTCOME:
Students able to
CO1: Relate with the smart resources, smart meters and other smart devices.
CO2: Explain the function of Smart Grid.
CO3: Experiment the issues of Power Quality in Smart Grid.
CO4: Analyze the performance of Smart Grid.
CO5: Recommend suitable communication networks for smart grid applications

REFERENCES

MAPPING OF CO’S WITH PO’S

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

CP4391 SECURITY PRACTICES

COURSE OBJECTIVES:
- To learn the core fundamentals of system and web security concepts
- To have thorough 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

CO-PO Mapping

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></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>
COURSE OBJECTIVES:
- To gain expertise in Virtualization, Virtual Machines and deploy practical virtualization solution
- To understand the architecture, infrastructure and delivery models of cloud computing.
- To explore the roster of AWS services and illustrate the way to make applications in AWS
- To gain knowledge in the working of Windows Azure and Storage services offered by Windows Azure
- To develop the cloud application using various programming model of Hadoop and Aneka

UNIT I VIRTUALIZATION AND VIRTUALIZATION INFRASTRUCTURE

UNIT II CLOUD PLATFORM ARCHITECTURE

UNIT III AWS CLOUD PLATFORM - IAAS

UNIT IV PAAS CLOUD PLATFORM

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

TOTAL: 45 PERIODS

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

REFERENCES

IF4072 DESIGN THINKING L T P C 3 0 0 3

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

UNIT I UX LIFECYCLE TEMPLATE 8

UNIT II CONTEXTUAL INQUIRY 10

UNIT III DESIGN THINKING, IDEATION, AND SKETCHING 9

UNIT IV UX GOALS, METRICS, AND TARGETS 8
Introduction. UX goals. UX target tables. Work roles, user classes, and UX goals. UX measures.

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

COURSE OBJECTIVES:
• To get familiarity with gamut of multimedia and its significance
• To acquire knowledge in multimedia components.
• To acquire knowledge about multimedia tools and authoring.
• To acquire knowledge in the development of multimedia applications.
• To explore the latest trends and technologies in multimedia

UNIT I INTRODUCTION

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

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

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

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

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

UNIT III MULTIMEDIA TOOLS

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

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

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

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

UNIT V  MULTIMEDIA APPLICATIONS FOR THE WEB AND MOBILE PLATFORMS  9


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:

UNIT II 
SEARCH METHODS AND VISUALIZATION


UNIT III 
MINING DATA STREAMS


UNIT IV 
FRAMEWORKS

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


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>
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


<table>
<thead>
<tr>
<th>MX4073</th>
<th>MEDICAL ROBOTICS</th>
<th>L T P C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>3 0 0 3</td>
</tr>
</tbody>
</table>

**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

**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

**TOTAL: 45 PERIODS**
CO3: Describe the application of robots in various surgeries
CO4: Design and analyze the robotic systems for rehabilitation
CO5: Design the wearable robots

REFERENCES

CO-PO Mapping

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td></td>
<td>2</td>
<td></td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td></td>
<td>2</td>
<td></td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td></td>
<td>2</td>
<td></td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Avg</td>
<td>2</td>
<td></td>
<td>1.8</td>
<td></td>
<td>2.6</td>
<td>2.3</td>
</tr>
</tbody>
</table>

VE4202 EMBEDDED AUTOMATION

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

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

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

UNIT – III HARDWARE AND SOFTWARE INTERFACING WITH 8-BIT SERIES CONTROLLERS

Lights and Switches - Stack Operation - Implementing Combinational Logic - Expanding I/O - Interfacing Analog To Digital Convertors - Interfacing Digital To Analog Convertors - LED Displays: Seven Segment Displays, Dot Matrix Displays - LCD Displays - Driving Relays - Stepper Motor Interface - Serial EEPROM - Real Time Clock - Accessing Constants Table - Arbitrary Waveform Generation - Communication Links - System Development Tools

UNIT – IV VISION SYSTEM


UNIT – V HOME AUTOMATION

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

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

REFERENCES:


CO-PO Mapping

<table>
<thead>
<tr>
<th>CO</th>
<th>PO1</th>
<th>PO2</th>
<th>PO3</th>
<th>PO4</th>
<th>PO5</th>
<th>PO6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
<td>1</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>
</tbody>
</table>

94
<table>
<thead>
<tr>
<th></th>
<th>5</th>
<th>1</th>
<th>3</th>
<th>1</th>
<th>1</th>
<th>1</th>
<th>3</th>
</tr>
</thead>
<tbody>
<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>
<td></td>
</tr>
</tbody>
</table>

**CX4016  ENVIRONMENTAL SUSTAINABILITY**

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

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

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

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

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

**TOTAL : 45 PERIODS**

**REFERENCES**


**TX4092  TEXTILE REINFORCED COMPOSITES**

### 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  9
Preparation, chemistry, properties and applications of thermoplastic and thermostet resins; mechanism of interaction of matrices and reinforcements; optimization of matrices

UNIT III  COMPOSITE MANUFACTURING  9
Classification; methods of composites manufacturing for both thermoplastics and thermosets-  Hand layup, Filament Winding, Resin transfer moulding, prepgres and autoclave moulding, pultrusion, vacuum impregnation methods, compression moulding; post processing of composites and composite design requirements

UNIT IV  TESTING  9
Fibre volume and weight fraction, specific gravity of composites, tensile, flexural, impact, compression, inter laminar shear stress and fatigue properties of thermostet and thermoplastic composites.

UNIT V  MECHANICS  9
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

REFERENCES

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
3 0 0 3

UNIT I  IPR  9

UNIT II  AGREEMENTS, TREATIES AND PATENT FILING PROCEDURES  9
disclosure/non-disclosure – Financial assistance for patenting – Introduction to existing schemes Patent licensing and agreement Patent infringement – Meaning, scope, litigation, case studies

UNIT III  BIOSAFETY

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

UNIT V  ENTREPRENEURSHIP DEVELOPMENT

TOTAL : 45 PERIODS

REFERENCES