Prerequisite for the programme: Offered if commitment for summer internship followed by projects is available for all students from industry and for collaboration with industry in delivering lectures for the subjects in all semesters in the curriculum.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

1. To enable graduates to possess skills to develop new innovation in the field of Electronics and Communication Engineering (Industry Integrated) using analytical reasoning and state-of-the-art approaches derived from the Engineering Sciences and Engineering practice.

2. To enable graduates to create useful systems, components, or processes through agile, skillful, and innovative analysis and design, while respecting economic, environmental, cultural, and ethical standards or constraints and acquire technical and managerial leadership positions in their chosen fields.

3. To enable graduates to engage in lifelong learning, adapt to evolving Technology, work in multidisciplinary research for designing innovative products & solutions.

4. To become Entrepreneurs, understand current professional issues and apply latest technologies for the betterment of the nation and society.

PROGRAM OUTCOMES (POs)

1. An ability to independently carry out research/investigation and development work to solve practical problems

2. An ability to write and present a substantial technical report/document

3. 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

4. To apply the core aspects of Electronics and Communication Engineering principles such as Signal Processing, Embedded Systems, Networking, and Semiconductor Technology for designing end to end electronic products catering industry requirements.

5. To identify and utilize the strengths of current technologies used in industries in the field of Microelectronics, Signal Processing and Communication Systems in implementing ICT enabled services for societal needs

6. To identify industrial needs and provide suitable design solutions for implementing IoT, Cyber Physical Systems for given specifications
ANNA UNIVERSITY, CHENNAI
NON- AUTONOMOUS COLLEGES AFFILIATED ANNA UNIVERSITY
M.E. ELECTRONICS AND COMMUNICATION ENGINEERING (INDUSTRY INTEGRATED)
REGULATIONS – 2021
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA AND SYLLABI
SEMESTER I

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>Periods PER Week</th>
<th>Total Contact Periods</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L    T   P</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4    4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2    2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3    3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3    3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2    2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**THEORY**

1. MA4156 Linear Algebra, Probability and Queueing Theory
2. RM4151 Research Methodology and IPR
3. VE4151 Embedded Controllers
4. II4101 Industrial Automation and Control
5. II4102 Virtual Instrumentation
6. EL4151 Modern Digital Communication Systems
7. Audit Course – I*

**PRACTICALS**

8. EL4161 Digital Communication systems Laboratory
9. II4111 Application Software and Simulation Laboratory

*Audit course is optional

**SEMESTER II**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Course Code</th>
<th>Course Title</th>
<th>Category</th>
<th>Periods PER Week</th>
<th>Total Contact Periods</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>L    T   P</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3    3</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3    3</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3    3</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3    3</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2    2</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

**THEORY**

1. II4201 ASIC and FPGA Design
2. II4202 Wireless Communication and Networking
3. II4203 Advanced in Internet of Things
4. MP4291 Cyber Physical Systems
5. Professional Elective I
6. Professional Elective II
7. Audit Course – II*

**PRACTICALS**

8. II4211 Internet of Things Applications Laboratory
9. II4212 Term Paper Writing and Seminar

*Audit course is optional

**Note:** Summer internship (in Industry) (30 days min)
### SEMESTER III

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Theory</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>II4301</td>
<td>Robotics and Automation</td>
<td>PCC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</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>3.</td>
<td></td>
<td>Professional Elective IV</td>
<td>PEC</td>
<td>3 0 2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>Open Elective</td>
<td>OEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>PRACTICALS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>II4311</td>
<td>Summer internship</td>
<td>EEC</td>
<td>0 0 0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>6.</td>
<td>II4312</td>
<td>Project Work I</td>
<td>EEC</td>
<td>0 0 12</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TOTAL</td>
<td></td>
<td>12 0 14</td>
<td>26</td>
<td>21</td>
</tr>
</tbody>
</table>

### SEMESTER IV

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PRACTICALS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>II4411</td>
<td>Project Work II</td>
<td>EEC</td>
<td>0 0 24</td>
<td>24</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TOTAL</td>
<td></td>
<td>0 0 24</td>
<td>24</td>
<td>12</td>
</tr>
</tbody>
</table>

**TOTAL NO. OF CREDITS: 76**

### PROFESSIONAL ELECTIVES

#### SEMESTER II, ELECTIVE I

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>EL4391</td>
<td>Optical Networks</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>NE4251</td>
<td>Network Security</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>MP4093</td>
<td>Soft Computing Techniques</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>II4092</td>
<td>System on Chip</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

#### SEMESTER II, ELECTIVE II

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>II4091</td>
<td>Industry 4.0</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>II4001</td>
<td>Broadband Access Technologies</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>II4002</td>
<td>Smart Antennas</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>EL4071</td>
<td>Electromagnetic Interference and Compatibility</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>
### SEMESTER III, ELECTIVE III

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>II4003</td>
<td>Healthcare Technologies and Internet of Medical Things</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>II4004</td>
<td>Cognitive Radio Communications</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>IF4092</td>
<td>Computer Vision</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>VL4073</td>
<td>MEMS and NEMS</td>
<td>PEC</td>
<td>3 0 0</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

### SEMESTER III, ELECTIVE IV

<table>
<thead>
<tr>
<th>S. NO.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>CATEGORY</th>
<th>PERIODS PER WEEK</th>
<th>TOTAL CONTACT PERIODS</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>II4005</td>
<td>Wireless Adhoc and Sensor Networks</td>
<td>PEC</td>
<td>3 0 2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>2.</td>
<td>II4006</td>
<td>Real Time Systems</td>
<td>PEC</td>
<td>3 0 2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>3.</td>
<td>II4007</td>
<td>Software Defined Networks</td>
<td>PEC</td>
<td>3 0 2</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>4.</td>
<td>CP4252</td>
<td>Machine Learning</td>
<td>PEC</td>
<td>3 0 2</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

### AUDIT COURSES (AC)
Registration for any of these courses is optional to students

<table>
<thead>
<tr>
<th>SL. NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>AX4091</td>
<td>English for Research Paper Writing</td>
<td>2 0 0</td>
<td>0</td>
</tr>
<tr>
<td>2.</td>
<td>AX4092</td>
<td>Disaster Management</td>
<td>2 0 0</td>
<td>0</td>
</tr>
<tr>
<td>3.</td>
<td>AX4093</td>
<td>Constitution of India</td>
<td>2 0 0</td>
<td>0</td>
</tr>
<tr>
<td>4.</td>
<td>AX4094</td>
<td>நற்றமிழ் இலக்கியம்</td>
<td>2 0 0</td>
<td>0</td>
</tr>
</tbody>
</table>

### LIST OF OPEN ELECTIVES FOR PG PROGRAMMES

<table>
<thead>
<tr>
<th>SL. NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>OCE431</td>
<td>Integrated Water Resources Management</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>OCE432</td>
<td>Water, Sanitation and Health</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>OCE433</td>
<td>Principles of Sustainable Development</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>OCE434</td>
<td>Environmental Impact Assessment</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>5.</td>
<td>OIC431</td>
<td>Blockchain Technologies</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>OIC432</td>
<td>Deep Learning</td>
<td>3 0 0</td>
<td>3</td>
</tr>
<tr>
<td>S. NO</td>
<td>COURSE CODE</td>
<td>COURSE TITLE</td>
<td>PERIODS PER WEEK</td>
<td>CREDITS</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>--------------------------------------------------</td>
<td>------------------</td>
<td>---------</td>
</tr>
<tr>
<td>7.</td>
<td>OME431</td>
<td>Vibration and Noise Control Strategies</td>
<td>3 0 0 3</td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>OME432</td>
<td>Energy Conservation and Management in Domestic Sectors</td>
<td>3 0 0 3</td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>OME433</td>
<td>Additive Manufacturing</td>
<td>3 0 0 3</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>OME434</td>
<td>Electric Vehicle Technology</td>
<td>3 0 0 3</td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>OME435</td>
<td>New Product Development</td>
<td>3 0 0 3</td>
<td></td>
</tr>
<tr>
<td>12.</td>
<td>OBA431</td>
<td>Sustainable Management</td>
<td>3 0 0 3</td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>OBA432</td>
<td>Micro and Small Business Management</td>
<td>3 0 0 3</td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>OBA433</td>
<td>Intellectual Property Rights</td>
<td>3 0 0 3</td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>OBA434</td>
<td>Ethical Management</td>
<td>3 0 0 3</td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>ET4251</td>
<td>IoT for Smart Systems</td>
<td>3 0 0 3</td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>ET4072</td>
<td>Machine Learning and Deep Learning</td>
<td>3 0 0 3</td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>PX4012</td>
<td>Renewable Energy Technology</td>
<td>3 0 0 3</td>
<td></td>
</tr>
<tr>
<td>19.</td>
<td>PS4093</td>
<td>Smart Grid</td>
<td>3 0 0 3</td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>CP4391</td>
<td>Security Practices</td>
<td>3 0 0 3</td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>MP4251</td>
<td>Cloud Computing Technologies</td>
<td>3 0 0 3</td>
<td></td>
</tr>
<tr>
<td>22.</td>
<td>IF4072</td>
<td>Design Thinking</td>
<td>3 0 0 3</td>
<td></td>
</tr>
<tr>
<td>23.</td>
<td>MU4153</td>
<td>Principles of Multimedia</td>
<td>3 0 0 3</td>
<td></td>
</tr>
<tr>
<td>24.</td>
<td>CX4016</td>
<td>Environmental Sustainability</td>
<td>3 0 0 3</td>
<td></td>
</tr>
<tr>
<td>25.</td>
<td>TX4092</td>
<td>Textile Reinforced Composites</td>
<td>3 0 0 3</td>
<td></td>
</tr>
<tr>
<td>26.</td>
<td>NT4002</td>
<td>Nanocomposite Materials</td>
<td>3 0 0 3</td>
<td></td>
</tr>
<tr>
<td>27.</td>
<td>BY4016</td>
<td>IPR, Biosafety and Entrepreneurship</td>
<td>3 0 0 3</td>
<td></td>
</tr>
</tbody>
</table>

**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>1.</td>
<td>MA4156</td>
<td>Linear Algebra, Probability and Queueing Theory</td>
<td>3 1 0 4</td>
<td></td>
<td>I</td>
</tr>
</tbody>
</table>

**PROFESSIONAL CORE COURSES (PCC)**

<table>
<thead>
<tr>
<th>S. NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
<th>SEMESTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>VE4151</td>
<td>Embedded Controllers</td>
<td>3 0 0 3</td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>2.</td>
<td>II4101</td>
<td>Industrial Automation and Control</td>
<td>3 0 0 3</td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>3.</td>
<td>II4102</td>
<td>Virtual Instrumentation</td>
<td>3 0 0 3</td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>4.</td>
<td>EL4151</td>
<td>Modern Digital Communication Systems</td>
<td>3 0 0 3</td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>5.</td>
<td>EL4161</td>
<td>Digital Communication systems Laboratory</td>
<td>0 0 3 1 . 5</td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>6.</td>
<td>II4111</td>
<td>Application Software and Simulation Laboratory</td>
<td>0 0 3 1 . 5</td>
<td></td>
<td>I</td>
</tr>
<tr>
<td>7.</td>
<td>II4201</td>
<td>ASIC and FPGA Design</td>
<td>3 0 0 3</td>
<td></td>
<td>II</td>
</tr>
<tr>
<td>8.</td>
<td>II4202</td>
<td>Wireless Communication and Networking</td>
<td>3 0 0 3</td>
<td></td>
<td>II</td>
</tr>
<tr>
<td>S. No.</td>
<td>COURSE CODE</td>
<td>COURSE TITLE</td>
<td>PERIODS PER WEEK</td>
<td>CREDITS</td>
<td>SEMESTER</td>
</tr>
<tr>
<td>-------</td>
<td>-------------</td>
<td>--------------</td>
<td>------------------</td>
<td>---------</td>
<td>----------</td>
</tr>
<tr>
<td>1.</td>
<td>RM4151</td>
<td>Research Methodology and IPR</td>
<td>2 0 0 2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>II4131</td>
<td>Summer internship</td>
<td>0 0 0 2</td>
<td>III</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>EL4311</td>
<td>Project Work I</td>
<td>0 0 12 6</td>
<td>III</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>EL4411</td>
<td>Project Work II</td>
<td>0 0 24 12</td>
<td>IV</td>
<td></td>
</tr>
</tbody>
</table>

**RESEARCH METHODOLOGY AND IPR COURSES (RMC)**

**EMPLOYABILITY ENHANCEMENT COURSES (EEC)**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>PERIODS PER WEEK</th>
<th>CREDITS</th>
<th>SEMESTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>II4203</td>
<td>Advanced in Internet of Things</td>
<td>3 0 0 3</td>
<td>II</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>MP4291</td>
<td>Cyber Physical Systems</td>
<td>3 0 2 4</td>
<td>II</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>II4211</td>
<td>Internet of Things Applications Laboratory</td>
<td>0 0 2 1</td>
<td>II</td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>II4301</td>
<td>Robotics and Automation</td>
<td>3 0 0 3</td>
<td>III</td>
<td></td>
</tr>
</tbody>
</table>

**SUMMARY**

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>NAME OF THE PROGRAMME: M.E. ELECTRONICS AND COMMUNICATION ENGINEERING (INDUSTRY INTEGRATED)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SUBJECT AREA</td>
</tr>
<tr>
<td></td>
<td>I</td>
</tr>
<tr>
<td>1.</td>
<td>FC</td>
</tr>
<tr>
<td>2.</td>
<td>PCC</td>
</tr>
<tr>
<td>3.</td>
<td>PEC</td>
</tr>
<tr>
<td>4.</td>
<td>RMC</td>
</tr>
<tr>
<td>5.</td>
<td>OEC</td>
</tr>
<tr>
<td>6.</td>
<td>EEC</td>
</tr>
<tr>
<td>7.</td>
<td>Non Credit/Audit Course</td>
</tr>
<tr>
<td>8.</td>
<td>TOTAL CREDIT</td>
</tr>
</tbody>
</table>
COURSE OBJECTIVES:
The objective of this course is to enable the student to
- grasp the basic concepts of Probability, Random variables, correlation and regression.
- characterize the phenomena which evolve with respect to time in a probabilistic manner.
- encourage students to develop a working knowledge of the ventral ideas of linear algebra.
- acquire skills in analyzing Queueing Models.
- develop a fundamental understanding of linear programming models and apply the simplex method for solving linear programming problems.

UNIT – I LINEAR ALGEBRA 12

UNIT – II PROBABILITY AND RANDOM VARIABLES 12

UNIT – III RANDOM PROCESSES 12

UNIT – IV QUEUEING THEORY 12

UNIT – V LINEAR PROGRAMMING 12

TOTAL: 60 PERIODS

COURSE OUTCOMES:
After the completion of the course, the student will be able to
- apply various methods in Linear Algebra to solve the system of linear equations.
- use two-dimensional random variables, correlations and regression in solving application problem.
- apply the ideas of Random Processes.
- understand the basic characteristic features of a queueing system and acquire skills in analyzing queueing models.
- apply the Simplex method for solving linear programming problems.

REFERENCES:

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

COURSE OBJECTIVES:
- To arrange the conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose
- To gather information in a measured and systematic manner to ensure accuracy and facilitate data analysis
- To transform and model the collected data to discover useful information for decision-making
- To create public awareness about the benefits of Intellectual property among students
- To Provide legal certainty to inventors/ Patent applicants

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

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

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

UNIT IV INTELLECTUAL PROPERTY RIGHTS 6

UNIT V PATENTS 6

TOTAL: 30 PERIODS
COURSE OUTCOMES:
- Ability to arrange the conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose
- Ability to gather information in a measured and systematic manner to ensure accuracy and facilitate data analysis
- Ability to transform and model the collected data to discover useful information for decision-making
- Ability to awareness about the benefits of Intellectual property
- Ability to take up legal certainty while applying for Patent

REFERENCES:

VE4151 EMBEDDED CONTROLLERS

COURSE OBJECTIVES:
- To study the architecture and programming of PIC microcontrollers.
- To learn interfacing with PIC microcontrollers.
- To understand the ARM processor architecture.
- To program using ARM Instruction Set.
- To design and develop embedded applications.

UNIT I PIC MICROCONTROLLER – ARCHITECTURE
RISC Vs CISC Architectures – PIC Architecture and Assembly Language Programming - Program Memory Organization- Branch, Call and Time Delay Loop - PIC I/O Port Programming - Arithmetic and Logic Instructions and Programs - PIC Bank Switching, Table Processing, Macros And Modules PIC Configuration Registers-PIC Hardware Connection-ROM Loaders.

UNIT II PIC INTERFACING
PIC Timer / Counter Programming - Timers 0 And 1- Programming Timers 2 and 3 -Serial Port Programming -Interrupt Programming -Flash / EEPROM Programming - Standard and Enhanced CCP Modules -Compare Mode Programming - Capture Mode Programming- PWM Programming- ECCP Programming.

UNIT III ARM ARCHITECTURE
UNIT IV  ARM PROGRAMMING  
ARM Instruction Set - Data Processing Instructions – Branch Instructions — Load Store Instructions – Software Interrupt Instruction – Program Status Register Instructions – Conditional Execution - Thumb Instruction Set-Thumb Programmers Model-Thumb Branch Instructions- Thumb Data Processing Instructions-Thumb Single Register Data Transfer- Thumb Multiple Register Data Transfer Instructions - Thumb Implementation.

UNIT V  EMBEDDED APPLICATIONS  

SUGGESTED ACTIVITIES:
1: Interfacing PIC microcontrollers with peripherals.
2: Assignments on programming ARM processors.
3: Design embedded systems for real – time applications.

COURSE OUTCOMES:
CO1: Understand the architecture of a PIC microcontroller.
CO2: Program using PIC microcontrollers.
CO3: Program using ARM processors.
CO4: Design interfacing circuits with PIC microcontrollers.
CO5: Design embedded applications to solve real world problems.

TOTAL:45 PERIODS

REFERENCES:

II4101  INDUSTRIAL AUTOMATION AND CONTROL  
L T P C  3 0 0 3

COURSE OBJECTIVES:
The students will be able to
- Understand PLC Instructions
- Develop Ladder Logic for working models
- Use SCADA programming
- Interface various sensors with Arduino for industrial Automation

UNIT I  PROGRAMMABLE LOGIC CONTROLLERS  
Programmable Logic Controllers (PLCs) – architecture-Types- features -Programming a PLC using ladder/connected Component workbench-Input & Output Modules- Bit Instructions- Timer & Counter Instructions- Comparison & Data Handling Instructions- Program Control Instructions-
Sequencing Instructions- PLC Programming Exercises for Industrial Applications- DOL starter - Star Delta starter- Automatic water level controller- Conveyor-Lift-Bottle filling and process control applications-Analog I/Os -High speed counter-PTO PWM and RTC

UNIT II SCADA SYSTEM 9
Evolution of SCADA, Various SCADA architectures, advantages and disadvantages of each system, SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Communication Network, SCADA Server Data acquisition systems, SCADA applications in Automation, SCADA –Memory tag, Device tag, Alarm logging, Data logging, OPC server- HMI Systems –DCS- DCS integration with PLC and Computers - Features of DCS

UNIT III ARDUINO AND SENSORS FOR INDUSTRIAL AUTOMATION AND CONTROL 9

UNIT IV DATA ACQUISITION SYSTEM 9
Data acquisition of digital and analog signals (input and output) – Stand alone, LabVIEW compatible, Mat lab compatible, Real time data acquisition and storing using different data acquisition cards. Retrieving the stored data for analysis – High level language programming for using data acquisition system

UNIT V PROCESS CONTROL AND PNEUMATICS 9

TOTAL: 45PERIODS

COURSE OUTCOMES:
The students will be able to
- Program PLC for Industrial Applications
- Interface PLC with working models
- Control Applications using SCADA programming
- Develop industrial Automationusing Arduino with various sensors

REFERENCES:
II4102 VIRTUAL INSTRUMENTATION

COURSE OBJECTIVES:
The students will be able to
- understand the basics of Virtual Instrumentation
- differentiate analog and digital I/Os
- use LabVIEW for experiments
- analyze tools and applications in VI

UNIT I REVIEW OF DIGITAL INSTRUMENTATION 8
Representation of Analog signals in the Digital domain – Review of quantization in amplitude and time axis, sample and hold, sampling theorem, ADC and DAC types.

UNIT II FUNDAMENTALS OF VIRTUAL INSTRUMENTATION 10
Concept of virtual instrumentation – PC based data acquisition – Typical on board DAQ card, Resolution and sampling frequency - Multiplexing of analog inputs – Single-ended and differential inputs – Different strategies for sampling of multi-channel analog inputs. Concept of universal DAQ card - Use of timer-counter and analog outputs on the universal DAQ card.

UNIT III CLUSTER OF INSTRUMENTS IN VI SYSTEM 10

UNIT IV GRAPHICAL PROGRAMMING ENVIRONMENT IN VI 10
Concepts of graphical programming language LabVIEW – Concept of VIs and sub VI – Graphs & charts – Dataflow programming - Loops – Case and sequence structures - Types of data – Arrays & clusters – Formula nodes –math scrip integration - Local and global variables – String and file I/O – Building executables and installers – Web publishing tools
UNIT V   ANALYSIS TOOLS AND SIMPLE APPLICATIONS IN VI

Build virtual instruments like oscilloscope, FFT analyzer – Windowing and filtering tools – Introduction of Electrical power measurement suite - Simple temperature ON/OFF controller – P-I-D controller design - Simulation of a simple second order system – Building autonomous embedded system using FPGA target

TOTAL:45 PERIODS

COURSE OUTCOMES:
The students will be able to
- use VI basics for Industrial Applications
- develop Virtual Instrumentation using LabVIEW
- use DAQ for Real Time Applications

REFERENCES:
1. Jovitha Jerome, Virtual Instrumentation using LabVIEW, PHI publications, 2010

EL4151 MODERN DIGITAL COMMUNICATION SYSTEMS

COURSE OBJECTIVES:
- To understand the coherent and non coherent receivers and their performance under AWGN channel conditions
- To understand the effect of signalling through bandlimited channels and Equalization techniques used to overcome ISI
- To understand different channel models, channel capacity and different block coding techniques
- To understand the principle of convolutional coding and different decoding techniques
- To understand the basics of OFDM as a multicarrier communication and CDMA as a multiuser communication technique.

UNIT I   COHERENT AND NON-COHERENT COMMUNICATION


UNIT II   EQUALIZATION TECHNIQUES

UNIT III BLOCK CODED DIGITAL COMMUNICATION 9
Architecture and performance – Binary block codes; – Shannon’s channel coding theorem; Channel capacity; Matched filter; Concepts of Spread spectrum communication – Coded BPSK and DPSK demodulators– Linear block codes; Hamming; Golay; Cyclic; BCH ; Reed – Solomon codes. Space time block codes.

UNIT IV CONVOLUTIONAL CODED DIGITAL COMMUNICATION 9

UNIT V MULTICARRIER AND MUTLIUSER COMMUNICATIONS 9
Single Vs multicarrier modulation, orthogonal frequency division multiplexing (OFDM), Modulation and demodulation in an OFDM system, An FFT algorithmic implementation of an OFDM system, Bit and power allocation in multicarrier modulation, Peak-to-average ratio in multicarrier modulation. Introduction to CDMA systems, multiuser detection in CDMA systems – optimum multiuser receiver, suboptimum detectors, successive interference cancellation.

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
CO1: Differentiate coherent and non coherent receivers and analyse their performance under AWGN channel conditions
CO2: Illustrate the effect of signalling through bandlimited channels and Equalization techniques used to overcome ISI
CO3: Determine the channel capacity and design various block coding techniques to combat channel errors
CO4: Construct convolutional coders and analyze the performance of different decoding techniques.
CO5: Describe the basics of OFDM as a multicarrier communication and CDMA as a multiuser communication technique.

TOTAL:45 PERIODS

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>-</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>-</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Avg</td>
<td>(13/5)=2.6</td>
<td>-</td>
<td>(15/5)=3</td>
<td>(14/5)=2.8</td>
<td>(5/5)=1</td>
<td>(8/5)=1.6</td>
</tr>
</tbody>
</table>

**COURSE OBJECTIVES:**
- To study & measure the performance of digital communication systems.
- To provide a comprehensive knowledge of Wireless Communication.
- To learn about the design of digital filter and its adaptive filtering algorithms.

**LIST OF EXPERIMENTS (MATLAB/SCILAB/CABVIEW)**

**USE APPROPRIATE SIMULATION TOOLS FOR THE FOLLOWING EXPERIMENTS:**

1. Generation & detection of binary digital modulation techniques using SDR
2. Spread Spectrum communication system-Pseudo random binary sequence generation-Baseband DSSS.
3. MIMO system transceiver design using MATLAB/SCILAB/LABVIEW
4. Performance evaluation of simulated CDMA system
5. Channel Coder/decoder design (block codes / convolutional codes/ turbo codes)
6. OFDM transceiver design using MATLAB/SCILAB/LABVIEW
7. Channel equalizer design using MATLAB (LMS, RLS algorithms)
8. Design and Analysis of Spectrum Estimators (Bartlett, Welch) using MATLAB
9. BER performance Analysis of M-ary digital Modulation Techniques (coherent & non coherent) in AWGN Environment using MATLAB/SCILAB/LABVIEW
10. Design and performance analysis of Lossless Coding Techniques - Huffman Coding and Lempel Ziv Algorithm using MATLAB/SCILAB/LABVIEW
12. Study of synchronization (frame, bit, symbol.)

**TOTAL : 45 PERIODS**

**COURSE OUTCOMES:**

Upon the completion of course, students are able to
- Implement the adaptive filtering algorithms
- Generate and detect digital communication signals of various modulation techniques using MATLAB.
- Evaluate cellular mobile communication technology and propagation model.
- Apply mathematical formulation to analyze spectrum estimation of a signal and bit rate determination of a transmission link
- Analyze the performance of optimization algorithms for equalizing the channel or noise/echo cancellation
- Able to design synchronization algorithm for Digital Communication systems
<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>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Ave</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

(13/6)=2.16 (18/6)=3 (11/6)=1.83 (14/6)=2.3 (14/6)=2.3 (7/6)=1.1

II4111 APPLICATION SOFTWARE AND SIMULATION
LABORATORY

COURSE OBJECTIVE:

- To develop skills in writing programs and simulation of experiments.

Programming and Simulation for laboratory experiments and Industrial Applications to be performed (10 to 14 experiments)

1. Generation of standard discrete time deterministic and random signals using simulation tools
2. Generation and detection of digital modulation techniques using simulation tools
3. Bit Error Rate Analysis of different modulation scheme in AWGN and Rayleigh fading environments using simulation tools
4. Outage Analysis of communication system in AWGN and Rayleigh fading environments using simulation tools
5. Communication system analysis using Universal Software Radio Platform
6. Design of electronic circuits for the given application and analyze its performance using simulation tools
7. Design and Testing of electronic circuits for the given application using simulation tools
8. Design and simulation of Potential Distribution/Field of the MOSFET using finite difference method.
9. Design and simulation of P-Channel and N-Channel MOSFET
10. Implementing Data communication with WIFI module
    i. Analog sensor monitoring
    ii. Digital input monitoring
11. Implementing IOT with sensors monitoring
    i. Analog sensor monitoring
    ii. Digital input monitoring
12. Implementing IOT with actuator control
    i. ON-OFF control
    ii. Analog control
13. Miniproject/Case Study

COURSE OUTCOMES:
On the successful completion of the course, the students will be able to
CO1: To design, simulate, test and analyze electronic circuits/systems for given specifications/applications
CO2: To design and simulate experiments and industrial applications based on communication systems using simulation tools
CO3: To simulate experiments using available hardware and tools and implement them

II4201 ASIC AND FPGA DESIGN

COURSE OBJECTIVES:
The students will be able to
- study the design flow of different types of ASIC.
- familiarize the different types of programming technologies and logic devices.
- learn the architecture of different types of FPGA.
- gain knowledge about partitioning, floor planning, placement and routing including circuit extraction of ASIC

UNIT I OVERVIEW OF ASIC AND PLD
Types of ASICs - Design flow – CAD tools used in ASIC Design – Programming Technologies: Antifuse – static RAM – EPROM and EEPROM technology, Programmable Logic Devices: ROMs and EPROMs – PLA – PAL. Gate Arrays – CPLDs and FPGAs

UNIT II ASIC PHYSICAL DESIGN
System partition - partitioning - partitioning methods – interconnect delay models and measurement of delay - floor planning - placement – Routing: global routing - detailed routing - special routing - circuit extraction - DRC

UNIT III LOGIC SYNTHESIS, SIMULATION AND TESTING

UNIT IV FIELD PROGRAMMABLE GATE ARRAYS

UNIT V SOC DESIGN
COURSE OUTCOMES:
The students will be able to
CO1: analyze the synthesis, Simulation and testing of systems.
CO2: apply different high performance algorithms in ASICs.
CO3: discuss the design issues of SOC.

TOTAL: 45 PERIODS

REFERENCES:

II4202 WIRELESS COMMUNICATION AND NETWORKING

COURSE OBJECTIVES:
- To understand the characteristics of wireless channels and the fundamental limits on the capacity of wireless channels
- Understand various types of local area networks, WiMax and wide area networks.
- Understand various wireless networking standards such as 3G and 4G.
- To interwork between WLAN and WWAN.
- To have a good understanding of emerging wireless networks such as Adhoc, Sensor networks and cooperative wireless networks.

UNIT I THE WIRELESS CHANNEL
Overview of wireless systems – Physical modeling for wireless channels – Time and Frequency coherence – Statistical channel models – Capacity of wireless Channel- Capacity of Flat Fading Channel — Channel Distribution Information known – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver – Capacity with Receiver diversity – Capacity comparisons – Capacity of Frequency Selective Fading channels.

UNIT II 3G EVOLUTIONS

UNIT III 4G AND BEYOND
Introduction to LTE-A – Requirements and Challenges, network architectures – EPC, E- UTRAN architecture - mobility management, resource management, services, channel - logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure.
UNIT IV | 5G COMPONENTS | 9
Introduction to WLAN – IEEE 802.11 and HIPERLAN, Bluetooth, WiMAX. Characteristics of MANETs, Table-driven and Source-initiated On Demand routing protocols, Hybrid protocols, Wireless Sensor networks- Classification, MAC and Routing protocols.

UNIT V | INTERWORKING CONCEPTS AND COOPERATIVE WIRELESS NETWORKS | 9
Interworking objectives and requirements, Schemes to connect WLANs and 3GNetworks, Session Mobility, Interworking Architectures for WLAN and GPRS. Introduction to User cooperation and cognitive systems- Relay channels- A general three node relay channel- Wireless relay channel- User cooperation in wireless networks- Two user cooperative network

TOTAL :45 PERIODS

COURSE OUTCOMES:
On successful completion of this course, student will be able to
CO1: Understand the concepts of wireless LAN, WAN and various wireless standards.
CO2: Work with different wireless networks.
CO3: Familiarize with advanced wireless networks such as Adhoc, Sensor networks and cooperative wireless networks.

REFERENCES:

II4203 | ADVANCED IN INTERNET OF THINGS | L T P C
3 0 0 3

OBJECTIVES:
- To understand the fundamentals of Internet of Things
- To learn about the basics of IoT protocols
- To build a small low cost embedded system using Raspberry Pi.
- To apply the concept of Internet of Things in the real world scenario.

UNIT I | INTRODUCTION TO IoT | 9
Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology
UNIT II  IoT ARCHITECTURE
M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture

UNIT III  IoT PROTOCOLS

UNIT IV  BUILDING IOT WITH RASPBERRY PI & ARDUINO

UNIT V  ADVANCED INTERNET OF THINGS
Smart Convergent technologies for IoT- SDN and NFV for IoT- The impact of IoT in 5G Mobile Communication- Fog Computing and Internet of Things- Big data Analytics in IoT- Energy harvesting and Power Management for IoT-Wearable Computing and Mixed reality and Internet of Everything- Privacy and Security in IoT- The world of future – Internet of Everything

TOTAL : 45 PERIODS

OUTCOMES
Upon completion of this course, the students should be able to:
• Analyze various protocols for IoT
• Develop web services to access/control IoT devices.
• Design a portable IoT using Rasperry Pi
• Deploy an IoT application and connect to the cloud.
• Analyze applications of IoT in real time scenario

REFERENCES:
6. Mike Miller, The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World, Que Publishing, 2015

MP4291 CYBER PHYSICAL SYSTEMS L T P C 3 0 2 4

COURSE OBJECTIVES:
- To learn about the principles of cyber-physical systems
- To familiarize with the basic requirements of CPS.
- To know about CPS models
- To facilitate the students to understand the CPS foundations
- To make the students explore the applications and platforms.
- To provide introduction to practical aspects of cyber physical systems.
- To equip students with essential tools to implement CPS.

UNIT I INTRODUCTION TO CYBER-PHYSICAL SYSTEMS 6

UNIT II CPS - REQUIREMENTS 12

UNIT III CPS MODELS 9

UNIT IV CPS FOUNDATIONS 9
Symbolic Synthesis for CPS- Security in CPS-Synchronization of CPS-Real-Time Scheduling for CPS

UNIT V APPLICATIONS AND PLATFORMS 9

LIST OF EXPERIMENTS (30)
1. Installation of Xilinx SDK, LABVIEW, MatLab and Cybersim
2. Installation of, myRIO iRobot Create Wiring, Kobuki Wiring
3. CPS DEsign with the iRobot Create
4. CPS Design with the Kobuki.
5. Write a program in MATLAB to implement open loop system stability.
6. Write a program in MATLAB to implement timed automation.

COURSE OUTCOMES:
CO1: Explain the core principles behind CPS
CO2: Discuss the requirements of CPS.
CO3: Explain the various models of CPS.
CO4: Describe the foundations of CPS.
CO5: Use the various platforms to implement the CPS.

TOTAL: 45+30=75 PERIODS

REFERENCES
7. documentation | KOBUKI (yujinrobot.com)

II4211 INTERNET OF THINGS APPLICATIONS LABORATORY L T P C 0 0 4 2

OBJECTIVES: The students will be able to
• Understand concepts of IoT and Cyber Physical Systems

LIST OF EXPERIMENTS:
Internet of Things Applications using the following experiments:
- Raspberry Pi – GPIO and Cloud
- Design and Develop Cloud based master and slave systems using Internet
- Explore different communication methods with IoT devices.
- To interface LED/Buzzer with platform/ Aurdino /Raspberry Pi. and write an embedded C program to turn on / off LED/Buzzer with specified delay
- To interface DC/stepper motor using relay with open platform/ Aurdino /Raspberry Pi and write an embedded C program to turn on motor if push button is pressed.
- Develop simple application – testing infrared sensor – IoT Applications – using open platform/Raspberry Pi.
Develop simple application to interface with DHT11 sensor and write a program to display temperature humidity readings in LCD.

Implement IoT with sensors monitoring: Analog sensor monitoring, Digital input monitoring

Implement IoT with actuator control: ON-OFF control, Analog control

Develop Internet of Medical Things (IoMT) Application using open platform/Arduino/Raspberry Pi and sensors such as temperature, ECG, Pulse etc.

Deploy IoMT applications using platforms.

Electromechanical modelling of QUBE Servo Inertia Disk system

Analysis of Physical system with RIO hardware integration (Step response, time domain, stability)

Mathematical modelling of Second-order system with PID Controller design control

Mathematical modelling of Pendulum system and design a balance control and swing-up control

OUTCOMES: The students will be able to

- Develop IoT and Cyber Physical System based Real Time Applications

II4212 TERM PAPER WRITING AND SEMINAR

L T P C 0 0 2 1

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (atleast 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analysing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Please keep a file where the work carried out by you is maintained.
Activities to be carried out
<table>
<thead>
<tr>
<th>Activity</th>
<th>Instructions</th>
<th>Submission week</th>
<th>Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection of area of interest and Topic</td>
<td>You are requested to select an area of interest, topic and state an objective</td>
<td>2nd week</td>
<td>3% Based on clarity of thought, current relevance and clarity in writing</td>
</tr>
<tr>
<td>Stating an Objective</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collecting Information about your area &amp; topic</td>
<td>1. List 1 Special Interest Groups or professional society</td>
<td>3rd week</td>
<td>3% ( the selected information must be area specific and of international and national standard)</td>
</tr>
<tr>
<td></td>
<td>2. List 2 journals</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3. List 2 conferences, symposia or workshops</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. List 1 thesis title</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. List 3 web presences (mailing lists, forums, news sites)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. List 3 authors who publish regularly in your area</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>7. Attach a call for papers (CFP) from your area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collection of Journal papers in the topic in the context of the objective – collect 20 &amp; then filter</td>
<td>• You have to provide a complete list of references you will be using - Based on your objective - Search various digital libraries and Google Scholar</td>
<td>4th week</td>
<td>6% ( the list of standard papers and reason for selection)</td>
</tr>
<tr>
<td></td>
<td>• When picking papers to read - try to:</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Favour papers from well-known journals and conferences,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Favour “first” or “foundational” papers in the field (as indicated in other people’s survey paper),</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Favour more recent papers,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Pick a recent survey of the field so you can quickly gain an overview,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Find relationships with respect to each other and to your topic area (classification scheme/categorization)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reading and notes for first 5 papers</td>
<td>Reading Paper Process</td>
<td>5th week</td>
<td>8% ( the table given should indicate your</td>
</tr>
<tr>
<td></td>
<td>• For each paper form a Table answering the following questions:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Repeat Reading Paper Process</td>
<td>Week</td>
<td>Notes</td>
</tr>
<tr>
<td>----------</td>
<td>-----------------------------</td>
<td>------</td>
<td>-------</td>
</tr>
<tr>
<td>Reading and notes for next 5 papers</td>
<td></td>
<td>6th week</td>
<td>8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)</td>
</tr>
<tr>
<td>Reading and notes for final 5 papers</td>
<td></td>
<td>7th week</td>
<td>8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)</td>
</tr>
<tr>
<td>Draft outline 1 and Linking papers</td>
<td>Prepare a draft Outline, your survey goals, along with a classification / categorization diagram</td>
<td>8th week</td>
<td>8% (this component will be evaluated based on the linking and classification among the papers)</td>
</tr>
<tr>
<td>Abstract</td>
<td>Prepare a draft abstract and give a presentation</td>
<td>9th week</td>
<td>6% (Clarity, purpose and conclusion) 6% Presentation &amp; Viva Voce</td>
</tr>
</tbody>
</table>
### II4301: ROBOTICS AND AUTOMATION

**OBJECTIVES:**
The students will be able to
- understand the basics of robotics for industrial needs
- understand how to select robotics according to different applications
- analyse material handling techniques

<table>
<thead>
<tr>
<th>UNIT</th>
<th>INTRODUCTION:</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of industrial robots - Load handling capacity - general considerations in Robotic material handling - material transfer - machine loading and unloading - CNC machine tool loading, Robot centered cell- robots for Industrial automation.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UNIT</th>
<th>ROBOTS FOR INSPECTION:</th>
<th>9</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>UNIT</th>
<th>END EFFECTORS:</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gripper force analysis and gripper design for typical applications - design of multiple degrees of freedom - active and passive grippers - Forward and inverse kinematics, DH matrices and Trajectory control.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
UNIT IV  SELECTION OF ROBOT  10
Factors influencing the choice of a robot - robot performance testing - economics of robotisation
- Impact of robot on industry and society.

UNIT V  MATERIAL HANDLING:  9
Concepts of material handling - principles and considerations in material handling systems design
- conventional material handling systems - industrial trucks, monorails, rail guided vehicles,
conveyor systems, cranes and hoists - advanced material handling systems - automated guided
vehicle systems - automated storage and retrieval systems (ASRS) - bar code
technology - radio frequency identification technology.

TOTAL: 45 PERIODS

OUTCOMES: The students will be able to
• assemble basic robot for industrial automation
• select robots for industrial applications
• use robots for material handling

REFERENCES:
1. Richard D Klafter, Thomas Achmielewski and MickaelNegin, —Robotic Engineering – An
4. Deb S R, "Robotics Technology and Flexible Automation", Tata McGraw Hill, New Delhi,
1994.

EL4391  OPTICAL NETWORKS  L T P C
3 0 0 3

COURSE OBJECTIVES:
• Understand the concepts of optical components and networks.
• To gain an understanding of various issues in designing a high speed, and huge bandwidth
optical network.
• To acquire knowledge of architecture and standards of optical networks.
• Thorough knowledge about the routing and access mechanism in optical networks.
• Thorough understanding of the scientific and engineering principles underlying the
photonic technology.

UNIT I  OPTICAL SYSTEM COMPONENTS  9
Light propagation in optical fibers-Loss & Bandwidth, System limitations, Non-Linear effect,
Solitons, Optical Network Components- Couplers, Isolators & Circulators, Multiplexers & Filters
Optical Amplifiers, Switches, Wavelength Converters.
UNIT II  \hspace{1cm} OPTICAL NETWORK ARCHITECTURES \hspace{1cm} 9
Introduction to Optical Networks; WDM networks, SONET / SDH, Metropolitan-Area Networks, Layered Architecture; Broadcast and Select Networks- Topologies for Broadcast Networks, Media-Access Control Protocols, Wavelength Routing Architecture. WOBAN and OTDM networks. Introduction to ASON.

UNIT III  \hspace{1cm} WAVELENGTH ROUTING NETWORKS \hspace{1cm} 9
The Optical layer, Node Designs, Optical layer cost tradeoff, Routing and Wavelength Assignment algorithms, Virtual Topology design, Architectural variations

UNIT IV  \hspace{1cm} PACKET SWITCHING AND ACCESS NETWORKS \hspace{1cm} 9

UNIT V  \hspace{1cm} NETWORK DESIGN AND MANAGEMENT \hspace{1cm} 9
Transmission system Engineering-system model, Power penalty-transmitter, receiver, Optical amplifiers, crosstalk, dispersion, wavelength stabilization; overall design consideration; Control and Management-Network management functions, Configuration management, Performance management, Fault management. Optical safety, Service interface.

COURSE OUTCOMES:
On completion of the course the student will be
CO1: able to design state-of-the-art optical networks.
CO2: able to implement optical network protocols.
CO3: able to design high speed networks using optical fibers
CO4: able to simulate access network
CO5: able to design the optical network infrastructure and network management methods.

TOTAL: 45 PERIODS

REFERENCES

NE4251  \hspace{1cm} NETWORK SECURITY \hspace{1cm} 3 0 0 3

COURSE OBJECTIVES:
- To learn the fundamentals of cryptography and its application to network security.
- To understand the mathematics behind cryptography.
- To learn about the security issues in internet protocol.
- To understand the security issues in other layers
- To study about intrusion detection and prevention system and wireless hacking.
UNIT I  INTRODUCTION TO NETWORK SECURITY  9
Security Services and Mechanisms – Vulnerabilities in wireless communications –security basics 
– Attack and its types Security essentials on layers - Electronic signatures – PKI and electronic certificate

UNIT II  SYMMETRIC AND ASYMMETRIC CIPHERS  9

UNIT III  SECURITY ISSUES IN INTERNET PROTOCOL  9

UNIT IV  SECURITY IN OTHER LAYERS  9

UNIT V  INTRUSION DETECTION AND PREVENTION SYSTEM(IDPS) AND WIRELESS HACKING  9

COURSE OUTCOMES:
CO1: To design cryptographic algorithms and carry out their implementation.
CO2: To carry out cryptanalysis on cipher.
CO3: To be able to design and implement security based internet protocols.
CO4: To carry out system security for other layers.
CO5: To understand the importance of intrusion detection and prevention system and wireless hacking.

TOTAL PERIODS: 45

REFERENCES
COURSE OBJECTIVES:
- To give the knowledge of soft computing theories fundamentals
- To provide the mathematical background for carrying out the optimization associated with neural network learning
- To familiarize the ideas of fuzzy sets, fuzzy logic, use of heuristics and Fuzzy Logic Control Systems
- To introduce the mathematical background for genetic algorithms
- To expose the hybrid soft computing systems and its applications

UNIT I SOFT COMPUTING FUNDAMENTALS

UNIT II NEURAL NETWORKS
Fundamental Models of ANN: McCulloch- Pitts Model –Hebb Network – Linear Separability

UNIT III FUZZY COMPUTING AND MODELING

UNIT IV GENETIC ALGORITHM AND APPLICATIONS

UNIT V HYBRID SOFT COMPUTING AND APPLICATIONS
COURSE OUTCOMES:
After completion of the course, the student will be able to:
CO1: Apply various soft computing concepts for practical applications
CO2: Choose and design suitable neural network for real time problems
CO3: Use fuzzy logic rules and reasoning to handle uncertainty and develop decision making and expert system
CO4: Describe the importance of genetic algorithms for solving combinatorial optimization problems
CO5: Analysis the various hybrid soft computing techniques and apply in real time problems

TOTAL: 45 PERIODS

REFERENCES:

II4092 SYSTEM ON CHIP L T P C 3 0 0 3

OBJECTIVE:
- To introduce architecture and design concepts underlying system on chips.
- Students can gain knowledge of designing SoCs.
- To impart knowledge about the hardware-software design of a modest complexity chip allthe way from specifications, modeling, synthesis and physical design.

UNIT I SYSTEM ARCHITECTURE: OVERVIEW 9
Components of the system – Processor architectures – Memory and addressing – system levelinterconnection – SoC design requirements and specifications – design integration – design complexity – cycle time, die area and cost, ideal and practical scaling, area-time-power tradeoff in processor design, Configurability.

UNIT II PROCESSOR SELECTION FOR SOC 9
UNIT III MEMORY DESIGN

UNIT IV INTERCONNECT ARCHITECTURES AND SOC CUSTOMIZATION

UNIT V FPGA BASED EMBEDDED PROCESSOR

TOTAL: 45 PERIODS

OUTCOMES:
Upon successful completion of the program the students shall
CO1: Explain all important components of a System-on-Chip and an embedded system, i.e.
CO2: digital hardware and embedded software;
CO3: Outline the major design flows for digital hardware and embedded software;
CO4: Discuss the major architectures and trade-offs concerning performance, cost and power
CO5: consumption of single chip and embedded systems;

REFERENCES:

II4091 INDUSTRY 4.0 L T P C
3 0 0 3

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

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

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

UNIT III

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

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

OUTCOMES:
The students will be able to
CO1: use Industry 4.0 for Industrial Applications
CO2: use IoT and IIoT for Industry 4.0
CO3: apply smart devices Industrial Applications

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

II4001 BROADBAND ACCESS TECHNOLOGIES

OBJECTIVES:
The students will be able to

- explain fundamental concepts related to broadband access technologies.
- understand the current and emerging wired and wireless access technologies.
- acquire knowledge about cable modems and fiber access technologies.
- have an exposure to different systems standards for next generation broadband access networks.

UNIT I REVIEW OF ACCESS TECHNOLOGIES
Phone-Line modem, cable-access, ISDN, Emerging Broad band Technologies, Cable DSL, Fiber and Wireless, Standards for access network.
UNIT II  DIGITAL SUBSCRIBER LINES  10
Asymmetric Digital subscriber lines (ADSL) – Rate Adaptive subscriber line (RADSL)-ISDN
Digital subscriber line (IDSL) - High bit rate DSL (HDSL)-Single line DSL (SDSL) - very high bit rate DSL (VDSL) - Standards for XDSL & Comparison.

UNIT III  CABLE MODEM  10

UNIT IV  FIBER ACCESS TECHNOLOGIES  10
Optical Fiber in access networks, Architecture and Technologies- Hybrid fiber – Coax (HFC) system, Switched Digital Video (SDV) – Passive optical networks (PON) – FTTX (FTTH, FTTB, FTTC, FTT cab) comparison, Broadband PON, Gigabit-Capable PON.

UNIT V  BROAD BAND WIRELESS  10
Fixed Wireless, Direct Broadcast Satellite (DBS), Multi channel multi point distribution services (MMDS), Local multi point distribution services (LMDS), and Wideband integrated Digital Interactive Services (WIDIS), Mobile Wireless 3G – IMT 2000 - Introduction to LTE-A.

TOTAL : 45 PERIODS

OUTCOMES: The students will be able to
to design systems meeting out the requirements of the recent standards.

- meet out the industry requirements for man power in next generation networks.
- contribute towards the enhancement of the existing wireless technologies.

REFERENCES:

OBJECTIVES:
- To understand smart antenna environments
- To learn channel models
- To learn algorithms for Multi target decision

UNIT I

UNIT II

UNIT III

UNIT IV
Optimal spatial filtering – adaptive algorithms for CDMA. Multi target decision – directed algorithm.

UNIT V
DOA estimation – conventional and subspace methods. ML estimation techniques. Estimation of the number of sources using eigen decomposition. Direction finding and true ranging PL systems. Elliptic and hyperbolic PL systems. TDOA estimation techniques.

TOTAL : 45 PERIODS

OUTCOMES:
- To compare algorithms for target decision
- To explain DOA estimation techniques

REFERENCES:
Course Objectives:

- To gain broad conceptual understanding of the various aspects of electromagnetic (EM) interference and compatibility
- To develop a theoretical understanding of electromagnetic shielding effectiveness
- To understand ways of mitigating EMI by using shielding, grounding and filtering
- To understand the need for standards and to appreciate measurement methods
- To understand how EMI impacts wireless and broadband technologies

Unit I: Introduction & Sources of EM Interference

Introduction - Classification of sources - Natural sources - Man-made sources - Survey of the electromagnetic environment.

Unit II: EM Shielding

Introduction - Shielding effectiveness - Far-field sources - Near-field sources - Low-frequency, magnetic field shielding - Effects of apertures

Unit III: Interference Control Techniques


Unit IV: EMC Standards, Measurements and Testing

Need for standards - The international framework - Human exposure limits to EM fields - EMC measurement techniques - Measurement tools - Test environments.

Unit V: EMC Considerations in Wireless and Broadband Technologies

Efficient use of frequency spectrum - EMC, interoperability and coexistence - Specifications and alliances - Transmission of high-frequency signals over telephone and power networks – EMC and digital subscriber lines - EMC and power line telecommunications.

Suggested Activities:

1. Investigate various case studies related to EMIC. Example: Chernobyl Disaster in 1986.
2. Develop some understanding about the design of EM shields in electronic system design and packaging.

Course Outcomes:

Upon completion of this course, the student will be able to

- CO1: Demonstrate knowledge of the various sources of electromagnetic interference
- CO2: Display an understanding of the effect of how electromagnetic fields couple through apertures, and solve simple problems based on that understanding
- CO3: Explain the EMI mitigation techniques of shielding and grounding
- CO4: Explain the need for standards and EMC measurement methods
- CO5: Discuss the impact of EMC on wireless and broadband technologies

Total: 45 Periods
REFERENCES

II4003 HEALTH CARE TECHNOLOGIES AND INTERNET OF MEDICAL THINGS LT PC 3 0 03

OBJECTIVES:
The students will be able to
- know the principles and applications of biomedical devices
- comprehend the basics of healthcare technologies
- understand the applications of computer in medicine
- comprehend the telemedicine technology
- understand the applications of IoT for medical field and IoMT

UNIT I BIOMEDICAL TRANSDUCERS AND AMPLIFIERS
Introduction to Anatomy & Physiology of Human Body - Categories and Characteristics of Transducer - Signal conditioning units - Multichannel data acquisition system - various types of recorders - necessity for low noise pre amplifiers - Difference amplifier - Chopper amplifier - Different types of electrode and its equivalent circuits.

UNIT II BIOPOTENTIAL RECORDING & MEASUREMENTS
ECG, EEG, EMG, PCG, EOG, ERG lead system and recording methods - typical waveform - frequency spectrum - abnormal waveform.

NON ELECTRICAL PARAMETER MEASUREMENTS: Respiration rate - Pulse rate - Temperature - Blood Pressure - O2, CO2 measurements - Respiratory volume measurement - BMR measurement - Plethysmography technique - Impedance technique - Bipolar and Tetrapolar circuits - Detection of various physiological parameters using impedance technique - Blood Flow meter - Biochemical measurements.

UNIT III COMPUTER APPLICATIONS IN MEDICINE
UNIT IV  TELEMEDICINE APPLICATIONS


UNIT V  CONNECTED HEALTH

E-Health – E-health services security and interoperability - Internet of Things (IoT) in Medical Field – Internet of Medical Things (IoMT) - Applications of IoMT – M- Helath - Connected Health –Innovations in Healthcare Techs.

OUTCOMES:
By the completion of this course the student will to
Identify various functional blocks present in biosignal acquisition system
- Design the data acquisition system.
- Analyze different biopotential characteristics and recording methods of biosignals.
- Develop measurement systems by selecting different types of sensors, signal conditioning circuits for acquiring and recording various physiological parameters.
- Use the Applications of Computers in Medicine
- Differentiate the Protocols behind encryption techniques for secure transmission of data.
- Use the techniques, skills, and tools necessary for Telemedicine
- Apply new knowledge as needed in Connected Health including IoMT in healthcare

REFERENCES:
1. Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer's, Biomedical Instrumentation and Measurements, Biomedical Instrumentation and Measurements, Prentice Hall, 2001
3. Webster J.G Medical Instrumentation application and design, John Wiley and sons New York 3rd edition 1999
OBJECTIVES:

- To enable the student to understand the evolving paradigm of cognitive radio communication and the enabling technologies for its implementation.
- To enable the student to understand the essential functionalities and requirements in designing software defined radios and their usage for cognitive communication.
- To expose the student to the evolving next generation wireless networks and their associated challenges.

UNIT I INTRODUCTION TO SDR
Definitions and potential benefits - software radio architecture evolution – foundations, technology tradeoffs and architecture implications - Antenna for Cognitive Radio.

UNIT II SDR ARCHITECTURE
Essential functions of the software radio - architecture goals - quantifying degrees of programmability - top level component topology - computational properties of functional components - interface topologies among plug and play modules, architecture partitions.

UNIT III INTRODUCTION TO COGNITIVE RADIOS
Marking radio self-aware, the cognition cycle - organization of cognition tasks - structuring knowledge for cognition tasks - Enabling location and environment awareness in cognitive radios – concepts, architecture, design considerations.

UNIT IV COGNITIVE RADIO ARCHITECTURE
Primary Cognitive Radio functions, Behaviors, Components, A–Priori Knowledge taxonomy, observe – phase data structures, Radio procedure knowledge encapsulation - components of orient, plan, decide phases, act phase knowledge representation, design rules.

UNIT V NEXT GENERATION WIRELESS NETWORKS
The XG Network architecture - spectrum sensing - spectrum management - spectrum mobility, spectrum sharing - upper layer issues - cross – layer design.

TOTAL: 45 PERIODS

OUTCOMES:

- The student would be able to appreciate the motivation and the necessity for cognitive radiocommunication strategies.
- The student would be able to evolve new techniques and demonstrate their feasibility using mathematical validations and simulation tools.
- The student would be able to demonstrate the impact of the evolved solutions in future wireless network design.

REFERENCES:


IF4092  COMPUTER VISION L T P C 3 0 0 3

COURSE OBJECTIVES:
- Articulate & apply standard computer vision concepts
- Implement standard image processing tasks
- Applying Clustering concept for Image Classification
- Identify practical constraints in computer vision application
- Architecture of an existing computer vision pipeline based on deep learning models

UNIT I  COMPUTER VISION 8

UNIT II  PIXEL-BASED MANIPULATIONS & TRANSFORMATION 8

UNIT III  STRUCTURE IDENTIFICATION 11

UNIT IV  CLUSTERING IMAGES & IMAGE RETRIEVAL 9

UNIT V IMAGE CLASSIFICATION USING DEEP LEARNING


SUGGESTED ACTIVITIES:
1: Identify and List various noises in the Image.
2: Identify Image Manipulation
3: Add colour descriptors and improve the search results.
4: Hierarchical k-means is a clustering method that applies k-means recursively to the clusters to create a tree of incrementally refined clusters
5: Image Classification using CNN

TOTAL:45 PERIODS

COURSE OUTCOMES:
CO1: Understand the basic knowledge, theories and methods of computer vision.
CO2: to understand the essentials of image processing concepts through mathematical interpretation.
CO3: Demonstrate a knowledge of a broad range of fundamental image processing and image analysis techniques
CO4: Apply Clustering algorithms for clustering.
CO5: Analyse cognitive tasks including image classification, recognition and detection through deep learning.

REFERENCES
1. Pro Processing for Images and Computer Vision with OpenCV, Bryan WC Chung, Apress, 2017
2. Programming Computer Vision with Python, Jan Erik Solem, O'Reilly Media, 2012
3. A PRACTICAL INTRODUCTION TO COMPUTER VISION WITH OPENCV, Kenneth Dawson-Howe, Wiley, 2014
COURSE OBJECTIVES:

- to introduce the concepts of Micro Electro Mechanical devices.
- to know the fabrication process of microsystems.
- to know the design concepts of micro sensors and micro actuators.
- to familiarize concepts of Quantum Mechanics and Nano systems.

UNIT I  OVERVIEW  9
New trends in Engineering and Science: Micro and Nanoscale systems, introduction to design of MEMS and NEMS, MEMS and NEMS – applications, devices and structures. Materials for MEMS: Silicon, Silicon compounds, polymers, metals

UNIT II  MEMS FABRICATION TECHNOLOGIES  9

UNIT III  MICRO SENSORS  9

UNIT IV  MICRO ACTUATORS  9

UNIT V  NANOSYSTEMS AND QUANTUM MECHANICS  9
Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Schrodinger Equation and Wave Function Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their Quantization, Molecular Wires and Molecular Circuits

COURSE OUTCOMES:
At the end of this course, the student will be able to:
CO1: Discuss micro sensors
CO2: Explain micro actuators
CO3: Outline nanosystems and Quantum mechanics
CO4: Design micro actuators for different applications
CO5: Analyze atomic structures

REFERENCES
II4005 WIRELESS ADHOC AND SENSOR NETWORKS L T P C 3 0 0 3

OBJECTIVES: The students will be able to

- understand the basics of Ad-hoc & Sensor Networks.
- learn various fundamental and emerging protocols of all layers.
- study about the issues pertaining to major obstacles in establishment and efficient
  manage of Ad-hoc and sensor networks.
- understand the nature and applications of Ad-hoc and sensor networks.
- understand various security practices and protocols of Ad-hoc and Sensor
  Networks.

UNIT I MAC & TCP IN AD HOC NETWORKS 9
Fundamentals of WLANs – IEEE 802.11 Architecture - Self configuration and Auto
Networks – Contention Based Protocols - TCP over Ad-Hoc networks-TCP protocol overview
- TCP and MANETs – Solutions for TCP over Ad-Hoc Networks.

UNIT II ROUTING IN AD HOC NETWORKS 9
Routing in Ad-Hoc Networks- Introduction-Topology based versus Position based Approaches-
Proactive, Reactive, Hybrid Routing Approach-Principles and issues – Location services - DREAM
– Quorums based location service – Grid – Forwarding strategies – Greedy packet forwarding –
Restricted directional flooding- Hierarchical Routing- Issues and Challenges in providing QoS.

UNIT III MAC, ROUTING & QOS IN WIRELESS SENSOR NETWORKS 9
Introduction – Architecture - Single node architecture – Sensor network design considerations
Design considerations – MAC Layer Protocols – IEEE 802.15.4 Zigbee – Link Layer and Error
Control issues - Routing Protocols – Mobile Nodes and Mobile Robots - Data Centric & Contention
Based Networking – Transport Protocols & QOS – Congestion Control issues – Application Layer
support.

UNIT IV SENSOR MANAGEMENT 9
Sensor Management - Topology Control Protocols and Sensing Mode Selection Protocols - Time
synchronization - Localization and positioning – Operating systems and Sensor Network
programming – Sensor Network Simulators.

UNIT V SECURITY IN AD HOC AND SENSOR NETWORKS 9
Anti-tamper techniques – water marking techniques – Defense against routing attacks - Secure
Adhoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba –
Sensor Network Security Protocols – SPINS.
LIST OF EXPERIMENTS

Wireless Adhoc and Sensor Networks

Any 10 experiments:

1. Network Simulator installation of wireless sensor network.
2. Write TCL script for transmission between mobile nodes.
3. Write TCL script for sensor nodes with different parameters.
4. Generate TCL script for UDP and CBR traffic in WSN nodes.
5. Implementation of routing protocol in NS2 for AODV protocol.
8. Study other wireless sensor network simulators (Mannasim. Contiki.).
10. Localisation: Centroid method using signal strength for weights.
11. Power Management: Explore functionality on SPOTs to take current and voltage measurements.
13. Contour tracking: Implement a lightweight distributed algorithm where nodes compute the contours using purely local information.
14. Alternative Platforms & Tools:
   • Introduce TinyOS and NesC;
   • Build and deploy Blink, CntToRfmAndLeds, RfmToLeds.
   • Learn to use the TOSSIM simulator.

OUTCOMES:

Upon Completion of the course, the students should be able to:

• Identify different issues in wireless ad hoc and sensor networks.
• To analyze protocols developed for ad hoc and sensor networks.
• To identify and address the security threats in ad hoc and sensor networks.
• Establish a Sensor network environment for different type of applications.

REFERENCES:

4. C.Siva Ram Murthy and B.S.Manoj, “Ad Hoc Wireless Networks – Architectures and

II4006 REAL TIME SYSTEMS L T P C 3 0 0 3

OBJECTIVES:
- To learn real time operating system concepts, the associated issues & Techniques.
- To understand design and synchronization problems in Real Time System.
- To explore the concepts of real time databases.
- To understand the evaluation techniques present in Real Time System.

UNIT I REAL TIME SYSTEM AND SCHEDULING 9

UNIT II SOFTWARE REQUIREMENTS ENGINEERING 9

UNIT III INTERTASK COMMUNICATION AND MEMORY MANAGEMENT 9

UNIT IV REAL TIME DATABASES 9
Real time Databases – Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk

UNIT V VALUATION TECHNIQUES AND CLOCK SYNCHRONIZATION 9

OUTCOMES:
Upon completion of this course, the students should be able to:
- Apply principles of real time system design techniques to develop real time applications.
- Make use of database in real time applications.
- Make use of architectures and behaviour of real time operating systems.
- Apply evaluation techniques in application.

List of Experiments
Real Time Systems
Any ten experiments

3. Develop DFD model (level-0, level-1 DFD and Data dictionary) of the project.
4. Develop Structured design for the DFD model developed.
5. Develop UML Use case model for a problem.
6. Develop sequence diagram.
7. Develop Class diagrams
9. Study and usage of any Design phase CASE tool
10. Performing the Design by using any Design phase CASE tools.
11. Develop test cases for unit testing and integration testing
12. Develop test cases for various white box and black box testing techniques.
13. Use MATLAB/Simulink to Control Qball
   - Safely turn on/off the qball and change the batteries,
   - Establish a wireless connection between qball and workstation
   - Work with Quarc and MATLAB/Simulink and compile and run models on both workstation and qball sides.
   - Receive and monitor the sensor data on the workstation,
   - Read back the joystick data on workstation
   - Send command to control rotors speed.
14. Develop socket programming class to do the following class objectives
   - Establish a TCP/IP connection
   - Bind to a TCP port
   - Listen to connection requests
   - Accept connection requests
   - Receive data
   - Send data
15. Develop Communication Program with Target and Display Sensors
Develop a cqstreamclient class to receive and display data of sensors of the Qball
16. Joystick Interface
• Develop a driver for joystick and build a cjoystick class
• Read back the joystick X,Y,Z and RZ data and display the data
17. Maneuver Qball by Joystick
Objectives
- Use ctimer class and cjoystick class to read back the joystick X,Y,Z and RZ data
- Develop a cqstreamsrv class to send the joystick data to qball
- Use ctimer class and cqstreamclient class to read the qball sensors and display it
- Use qball_motor_control Simulink model to send the sensors data to SPC and receive commands from SPC to control the motors speeds.

REFERENCES:

II4007 SOFTWARE DEFINED NETWORKS LT P C
3 0 0 3

Objectives
• To learn about what software defined networks are
• To understand the separation of the data plane and the control plane
• To learn about the use of SDN in data centers
• To learn about different applications of SDN

UNIT I INTRODUCTION
History of Software Defined Networking (SDN) – Modern Data Center – Traditional Switch Architecture – Why SDN – Evolution of SDN – How SDN Works – Centralized and Distributed Control and Date Planes

UNIT II OPEN FLOW & SDN CONTROLLERS
Open Flow Specification – Drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor Based Overlays – SDN via Opening up the Device – SDN Controllers – General Concepts

UNIT III DATA CENTERS
Multitenant and Virtualized Multitenant Data Center – SDN Solutions for the Data Center Network – VLANs – EVPN – VxLAN – NVGRE
UNIT IV  SDN PROGRAMMING  
Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs – Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications.

UNIT V  SDN  
Juniper SDN Framework – IETF SDN Framework – Open Daylight Controller – Floodlight Controller – Bandwidth Calendaring – Data Center Orchestration

TOTAL :45 PERIODS

LIST OF LAB EXPERIMENTS:

Software Defined Network (SDN) experiments

( using Mininet and POX Controller)

Any ten experiments

Lab 1: basic mininet operations
Lab 2: manually control the switch
Lab 3: move the rules to the POX controller
Lab 4: set different forwarding rules for each switch in the controller
Lab 5: set traffic to different output queues (QoS issue)
Lab 6: FlowVisor
Lab 7: Multiple Tables Test
Lab 8: IP Load Balancer
Lab 9: Traffic measurement 1, Traffic measurement 2 (IP -> IP with mask -- TCP/UDP/ICMP)
Lab 10: Duplicate Packets
Lab 11: Bridge remote mininets using VXLAN
Lab 12: Using l2_multi to find a shortest path

( implement Floyd-Warshall algorithm: find the shortest paths between all pairs of vertices.)
Lab 13: Using l2_bellmanford to find a shortest path
(Bellman-Ford algorithm: computes the shortest paths from a single source to all of the other vertices)

Lab 14: Traffic Volume Control

Lab 15: A host with two interfaces

- Ring Topology
- Three Hosts
- switch_host1  switch_host2  switch_host3
- application layer routing

Lab 16: IPv6 example

Lab 17: IPv4 GRE Tunnel

OUTCOMES:
Upon completion of the course, the students will be able to
- Critically analyze and appreciate the evolution of software defined networks
- Point out the various components of SDN and their uses
- Explain the use of SDN in the current networking scenario
- Design and develop various applications of SDN

TEXT BOOKS:

REFERENCES:

CP4252       MACHINE LEARNING       L T P C       3 0 2 4

COURSE OBJECTIVES:
- To understand the concepts and mathematical foundations of machine learning and types of problems tackled by machine learning
- To explore the different supervised learning techniques including ensemble methods
- To learn different aspects of unsupervised learning and reinforcement learning
- To learn the role of probabilistic methods for machine learning
- To understand the basic concepts of neural networks and deep learning
UNIT I INTRODUCTION AND MATHEMATICAL FOUNDATIONS


UNIT II SUPERVISED LEARNING


UNIT III UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING


UNIT IV PROBABILISTIC METHODS FOR LEARNING


UNIT V NEURAL NETWORKS AND DEEP LEARNING

Neural Networks – Biological Motivation - Perceptron – Multi-layer Perceptron – Feed Forward Network – Back Propagation- Activation and Loss Functions- Limitations of Machine Learning – Deep Learning– Convolution Neural Networks – Recurrent Neural Networks – Use cases

45 PERIODS

SUGGESTED ACTIVITIES:

1. Give an example from our daily life for each type of machine learning problem
2. Study at least 3 Tools available for Machine Learning and discuss pros & cons of each
3. Take an example of a classification problem. Draw different decision trees for the example and explain the pros and cons of each decision variable at each level of the tree
4. Outline 10 machine learning applications in healthcare
5. Give 5 examples where sequential models are suitable.
6. Give at least 5 recent applications of CNN

PRACTICAL EXERCISES:

1. Implement a Linear Regression with a Real Dataset (https://www.kaggle.com/harrywang/housing). Experiment with different features in building a model. Tune the model's hyperparameters.
2. Implement a binary classification model. That is, answers a binary question such as "Are houses in this neighborhood above a certain price?" (use data from exercise 1). Modify the classification threshold and determine how that modification influences the model. Experiment with different classification metrics to determine your model's effectiveness.
3. Classification with Nearest Neighbors. In this question, you will use the scikit-learn's KNN classifier to classify real vs. fake news headlines. The aim of this question is for you to read
the scikit-learn API and get comfortable with training/validation splits. Use California Housing Dataset

4. In this exercise, you'll experiment with validation sets and test sets using the dataset. Split a training set into a smaller training set and a validation set. Analyze deltas between training set and validation set results. Test the trained model with a test set to determine whether your trained model is overfitting. Detect and fix a common training problem.

5. Implement the k-means algorithm using https://archive.ics.uci.edu/ml/datasets/Codon+usage dataset

6. Implement the Naïve Bayes Classifier using https://archive.ics.uci.edu/ml/datasets/Gait+Classification dataset

7. Project - (in Pairs) Your project must implement one or more machine learning algorithms and apply them to some data.

   a. Your project may be a comparison of several existing algorithms, or it may propose a new algorithm in which case you still must compare it to at least one other approach.
   b. You can either pick a project of your own design, or you can choose from the set of pre-defined projects.
   c. You are free to use any third-party ideas or code that you wish as long as it is publicly available.
   d. You must properly provide references to any work that is not your own in the write-up.
   e. Project proposal You must turn in a brief project proposal. Your project proposal should describe the idea behind your project. You should also briefly describe software you will need to write, and papers (2-3) you plan to read.

List of Projects (datasets available)

1. Sentiment Analysis of Product Reviews
2. Stock Prediction
3. Sales Forecasting
4. Music Recommendation
5. Handwriting Digit Classification
6. Fake News Detection
7. Sports Prediction
8. Object Detection
9. Disease Prediction

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

CO1: Understand and outline problems for each type of machine learning
CO2: Design a Decision tree and Random forest for an application
CO3: Implement Probabilistic Discriminative and Generative algorithms for an application and analyze the results.
CO4: Use a tool to implement typical Clustering algorithms for different types of applications.
CO5: Design and implement an HMM for a Sequence Model type of application and identify applications suitable for different types of Machine Learning with suitable justification.

TOTAL:75 PERIODS

REFERENCES

9. Trevor Hastie, Robert Tibshirani, Jerome Friedman, "The Elements of Statistical Learning", Springer, 2009 (freely available online)

AUDIT COURSES

AX4091 ENGLISH FOR RESEARCH PAPER WRITING

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

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

UNIT II PRESENTATION SKILLS 6

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

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

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

TOTAL: 30 PERIODS
COURSE OUTCOMES:
CO1 – Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

REFERENCES:

AX4092 DISASTER MANAGEMENT L T P C
2 0 0 0

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

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

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS 6

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

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

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

TOTAL : 30 PERIODS

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

REFERENCES:

AX4093 CONSTITUTION OF INDIA

COURSE 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

COURSE OUTCOMES:
Students will be able to:

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

SUGGESTED READING
1. The Constitution of India,1950(Bare Act),Government Publication.
UNIT II

அறநநறிக் கதுப்
1. அறநநறிக் கதுப் சிவயல்நாடை்
   - அறநநறிக் சிவயல்நாடை், அறநநறிக் சிவயல்நாடை், சிவயல்நாடை், போன்ற கதுப்
2. பொது அறநநறிக் - தீர்ச்சியான கதுப்
   - தீர்ச்சியான கதுப், தீர்ச்சியான கதுப் (சமவெளியான தீர்ச்சியான கதுப்)

UNIT III

இரண்டாம் கப்புப்பக்கது
1. கல்வியறிவின் பராம
   - கல்வியறிவின் பராம
2. சுருக்கக் கல்வியறிவின் பராம
   - சுருக்கக் கல்வியறிவின் பராம

UNIT IV

ஏழாம் கதுப்
1. சிறுபொணொற்றுப்பகட
   - பொழுதி சிறுபொணொற்றுப்பகட, சிறுபொணொற்றுப்பகட, அறிவுபொணொற்றுப்பகட
2. தொல்லியல்
   - அறநநறிக் பொழுதி சிறுபொணொற்றுப்பகட
3. கிலையறிவு (617, 618)
   - கிலையறிவு தொல்லியல் விளக்க
4. தர்மக்கலத்து திருக்குநாள்
5. புறநொனூறு
   - சிறுபானசு வழக்கான
6. அகநொனூறு (4)
   - அகநொனூறு (11)
   - அகநொனூறு (11)
   - பாய்வு, பாய்வு
   - கிலையறிவு 50 (27)
   - தொல்லியல் சிறுபொணொற்றுப் பராம

UNIT V

நவீன தமிழ் இலக்கியம்
1. உறுதிகக்குறைன் பகட
   - உறுதிகக்குறைன் பகட, உறுதிகக்குறைன் பகட
2. தமிழ் சிறுபஞ்சம் பகட
3. தமிழ் சிறுபஞ்சம் பகட
4. தமிழ் சிறுபஞ்சம் பராமதியறிவின் பராம
5. தமிழ் சிறுபஞ்சம் பராமதியறிவின் பராம
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  9
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  9
Water for food production: ‘blue’ versus ‘green’ water debate – Water foot print - Virtual water trade for achieving global water and food security — Irrigation efficiencies, irrigation methods - current water pricing policy– scope to relook pricing.

TOTAL: 45 PERIODS

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

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

REFERENCES:

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

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

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

UNIT II  MANAGERIAL IMPLICATIONS AND IMPACT  9
Third World Scenario – Poor and Multidimensional Deprivation--Health Burden in Developing Scenario -Factors contribute to water, sanitation and hygiene related diseases-Social: Social Stratification and Literacy Demography: Population and Migration- Fertility - Mortality-

UNIT III CHALLENGES IN MANAGEMENT AND DEVELOPMENT

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

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

TOTAL: 45 PERIODS

OUTCOMES:

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

REFERENCES
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

TOTAL: 45 PERIODS
OUTCOMES:

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

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

REFERENCES:


OCE434 ENVIRONMENTAL IMPACT ASSESSMENT

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 INDENTIFICATION AND PREDICTION


UNIT III SOCIO-ECONOMIC IMPACT ASSESSMENT

Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. factors and methodologies- individual and family level impacts. communities in transition-rehabilitation
UNIT IV EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN

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

UNIT V CASE STUDIES

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

TOTAL: 45 PERIODS

OUTCOMES:

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

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

REFERENCES:

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

OIC431 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
9
Introduction to Blockchain, Blockchain Technology Mechanisms & Networks, Blockchain Origins, Objective of Blockchain, Blockchain Challenges, Transactions and Blocks, P2P Systems, Keys as Identity, Digital Signatures, Hashing, and public key cryptosystems, private vs. public Blockchain.

UNIT II
BITCOIN AND CRYPTOCURRENCY
9

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

UNIT IV
INTRODUCTION TO HYPERLEDGER AND SOLIDITY PROGRAMMING
10

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

TOTAL: 45 PERIODS

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

REFERENCES:

OIC432 DEEP LEARNING

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

UNIT I  DEEP LEARNING CONCEPTS 6

UNIT II  NEURAL NETWORKS 9

UNIT III  CONVOLUTIONAL NEURAL NETWORK 10

UNIT IV  NATURAL LANGUAGE PROCESSING USING RNN 10

UNIT V  DEEP REINFORCEMENT & UNSUPERVISED LEARNING 10

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

TOTAL : 45 PERIODS

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

OME431 VIBRATION AND NOISE CONTROL STRATEGIES L T P C
3 0 0 3

OBJECTIVES
- To appreciate the basic concepts of vibration in damped and undamped systems
- To appreciate the basic concepts of noise, its effect on hearing and related terminology
- To use the instruments for measuring and analyzing the vibration levels in a body
- To use the instruments for measuring and analyzing the noise levels in a system
- To learn the standards of vibration and noise levels and their control techniques

UNIT- I BASICS OF VIBRATION

UNIT- II BASICS OF NOISE
Introduction - Anatomy of human ear - Mechanism of hearing - Amplitude, frequency, wavelength and sound pressure level - Relationship between sound power, sound intensity and sound pressure level - Addition, subtraction and averaging decibel levels - sound spectra -Types of sound fields - Octave band analysis - Loudness.

UNIT- III INSTRUMENTATION FOR VIBRATION MEASUREMENT

UNIT- IV INSTRUMENTATION FOR NOISE MEASUREMENT AND ANALYSIS
Microphones - Weighting networks - Sound Level meters, its classes and calibration - Noise measurements using sound level meters - Data Loggers - Sound exposure meters - Recording of noise - Spectrum analyser - Intensity meters - Energy density sensors - Sound source localization.

UNIT- V METHODS OF VIBRATION CONTROL, SOURCES OF NOISE AND ITS CONTROL
sources and its strategies – Noise control at the source – Noise control along the path – Acoustic Barriers – Noise control at the receiver -- Sound transmission through barriers – Noise reduction Vs Transmission loss - Enclosures

TOTAL: 45 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
1. apply the basic concepts of vibration in damped and undamped systems
2. apply the basic concepts of noise and to understand its effects on systems
3. select the instruments required for vibration measurement and its analysis
4. select the instruments required for noise measurement and its analysis.
5. recognize the noise sources and to control the vibration levels in a body and to control noise under different strategies.

REFERENCES:

OME432 ENERGY CONSERVATION AND MANAGEMENT IN DOMESTIC SECTORS

COURSE OBJECTIVES:
1. To learn the present energy scenario and the need for energy conservation.
2. To understand the different measures for energy conservation in utilities.
3. Acquaint students with principle theories, materials, and construction techniques to create energy efficient buildings.
4. To identify the energy demand and bridge the gap with suitable technology for sustainable habitat
5. To get familiar with the energy technology, current status of research and find the ways to optimize a system as per the user requirement

UNIT I ENERGY SCENARIO

UNIT II HEATING, VENTILLATION & AIR CONDITIONING

UNIT III LIGHTING, COMPUTER, TV
UNIT IV  ENERGY EFFICIENT BUILDINGS  9

UNIT V  ENERGY STORAGE TECHNOLOGIES  9
Necessity & types of energy storage – Thermal energy storage – Battery energy storage, charging and discharging– Hydrogen energy storage & Super capacitors – energy density and safety issues – Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Understand technical aspects of energy conservation scenario.
2. Energy audit in any type for domestic buildings and suggest the conservation measures.
3. Perform building load estimates and design the energy efficient landscape system.
4. Gain knowledge to utilize an appliance/device sustainably.
5. Understand the status and current technological advancement in energy storage field.

REFERENCES:
   (Could be downloaded from www.energymanagertraining.com)
UNIT III VAT POLYMERIZATION 9

UNIT IV MATERIAL EXTRUSION AND SHEET LAMINATION 9

POWDER BASED PROCESS

UNIT V CASE STUDIES AND OPPORTUNITIES ADDITIVE MANUFACTURING PROCESSES 9

TOTAL: 45 PERIODS

REFERENCES:

OME434 ELECTRIC VEHICLE TECHNOLOGY L T P C
3 0 0 3

UNIT I NEED FOR ELECTRIC VEHICLES 9
History and need for electric and hybrid vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies, comparison of diesel, petrol, electric and hybrid vehicles, limitations, technical challenges
UNIT II  ELECTRIC VEHICLE ARCHITECHTURE  9
Electric vehicle types, layout and power delivery, performance – traction motor characteristics, tractive effort, transmission requirements, vehicle performance, energy consumption, Concepts of hybrid electric drive train, architecture of series and parallel hybrid electric drive train, merits and demerits, mild and full hybrids, plug-in hybrid electric vehicles and range extended hybrid electric vehicles, Fuel cell vehicles.

UNIT III  ENERGY STORAGE  9
Batteries – types – lead acid batteries, nickel based batteries, and lithium based batteries, electrochemical reactions, thermodynamic voltage, specific energy, specific power, energy efficiency, Battery modeling and equivalent circuit, battery charging and types, battery cooling, Ultra-capacitors, Flywheel technology, Hydrogen fuel cell, Thermal Management of the PEM fuel cell

UNIT IV  ELECTRIC DRIVES AND CONTROL  9
Types of electric motors – working principle of AC and DC motors, advantages and limitations, DC motor drives and control, Induction motor drives and control, PMSM and brushless DC motor - drives and control, AC and Switch reluctance motor drives and control – Drive system efficiency – Inverters – DC and AC motor speed controllers

UNIT V  DESIGN OF ELECTRIC VEHICLES  9

REFERENCES:

TOTAL: 45 PERIODS

OME435  NEW PRODUCT DEVELOPMENT  L  T  P  C
3 0 0 3

COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for:
1. Applying the principles of generic development process; and understanding the organization structure for new product design and development.
2. Identifying opportunity and planning for new product design and development.
3. Conducting customer need analysis; and setting product specification for new product design and development.
4. Generating, selecting, and testing the concepts for new product design and development.
5. Applying the principles of Industrial design and prototype for new product design and development.

UNIT I
INTRODUCTION TO PRODUCT DESIGN & DEVELOPMENT


UNIT II
OPPORTUNITY IDENTIFICATION & PRODUCT PLANNING


UNIT III
IDENTIFYING CUSTOMER NEEDS & PRODUCT SPECIFICATIONS


UNIT IV
CONCEPT GENERATION, SELECTION & TESTING


UNIT V
INDUSTRIAL DESIGN & PROTOTYPING


TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Apply the principles of generic development process; and understand the organization structure for new product design and development.
2. Identify opportunity and plan for new product design and development.
3. Conduct customer need analysis; and set product specification for new product design and development.
4. Generate, select, and test the concepts for new product design and development.
5. Apply the principles of Industrial design and prototype for design and develop new products.

TEXT BOOK:

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

UNIT I MANAGEMENT OF SUSTAINABILITY 9
Management of sustainability - rationale and political trends: An introduction to sustainability management, International and European policies on sustainable development, theoretical pillars in sustainability management studies.

UNIT II CORPORATE SUSTAINABILITY AND RESPONSIBILITY 9
Corporate sustainability parameter, corporate sustainability institutional framework, integration of sustainability into strategic planning and regular business practices, fundamentals of stakeholder engagement.

UNIT III SUSTAINABILITY MANAGEMENT: STRATEGIES AND APPROACHES 9
Corporate sustainability management and competitiveness: Sustainability-oriented corporate strategies, markets and competitiveness, Green Management between theory and practice, Sustainable Consumption and Green Marketing strategies, Environmental regulation and strategic postures; Green Management approaches and tools; Green engineering: clean technologies and innovation processes; Sustainable Supply Chain Management and Procurement.

UNIT IV SUSTAINABILITY AND INNOVATION 9
Socio-technical transitions and sustainability, Sustainable entrepreneurship, Sustainable pioneers in green market niches, Smart communities and smart specializations.

UNIT V SUSTAINABLE MANAGEMENT OF RESOURCES, COMMODITIES AND COMMONS 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: An understanding of sustainability management as an approach to aid in evaluating and minimizing environmental impacts while achieving the expected social impact.
CO2: An understanding of corporate sustainability and responsible Business Practices
CO3: Knowledge and skills to understand, to measure and interpret sustainability performance.
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

OBA432 MICRO AND SMALL BUSINESS MANAGEMENT

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

UNIT I INTRODUCTION TO SMALL BUSINESS

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

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

UNIT IV FINANCING SMALL BUSINESS
Main sources of entrepreneurial capital; Nature of ‘bootstrap’ financing - Difference between cash and profit - Nature of bank financing and equity financing - Funding-equity gap for small firms. Importance of working capital cycle - Calculation of break-even point - Power of gross profit margin- Pricing for profit - Credit policy issues and relating these to cash flow management and profitability.
UNIT V VALUING SMALL BUSINESS AND CRISIS MANAGEMENT 9
Causes of small business failure - Danger signals of impending trouble - Characteristics of poorly performing firms - Turnaround strategies - Concept of business valuation - Different valuation measurements - Nature of goodwill and how to measure it - Advantages and disadvantages of buying an established small firm - Process of preparing a business for sale.
TOTAL: 45 PERIODS

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

REFERENCES
3. Journal articles on SME's.

OBA433 INTELLECTUAL PROPERTY RIGHTS L T P C
3 0 0 3

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

UNIT I INTRODUCTION 9
Intellectual property rights - Introduction, Basic concepts, Patents, Copyrights, Trademarks, Trade Secrets, Geographic Indicators; Nature of Intellectual Property, Technological Research, Inventions and Innovations, History - the way from WTO to WIPO, TRIPS.

UNIT II PROCESS 9
New Developments in IPR, Procedure for grant of Patents, TM, GIs, Patenting under Patent Cooperation Treaty, Administration of Patent system in India, Patenting in foreign countries.

UNIT III STATUTES 9

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

**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.
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

ET4251 IoT FOR SMART SYSTEMS

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

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

UNIT II IOT ARCHITECTURE

UNIT III PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT
PROTOCOLS:
NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe GSM, CDMA, LTE, GPRS, small cell.
Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems-Recent trends.

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

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

TOTAL: 45 PERIODS

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

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

UNIT I LEARNING PROBLEMS AND ALGORITHMS 9
Various paradigms of learning problems, Supervised, Semi-supervised and Unsupervised algorithms

UNIT II NEURAL NETWORKS 9

UNIT III MACHINE LEARNING – FUNDAMENTALS & FEATURE SELECTIONS & CLASSIFICATIONS 9
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 9
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 9
State, Structure of RNN Cell, LSTM and GRU, Time distributed layers, Generating Text, Autoencoders: Convolutional Autoencoders, Denoising autoencoders, Variational autoencoders, GANs: The discriminator, generator, DCGANs

TOTAL : 45 PERIODS

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

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

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

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

UNIT II SOLAR PHOTOVOLTAICS

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

UNIT IV WIND ENERGY CONVERSION SYSTEMS
UNIT V OTHER RENEWABLE ENERGY SOURCES

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

TOTAL : 45 PERIODS

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

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

REFERENCES:

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  9
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  9

UNIT V  HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS  9
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

CP4391  SECURITY PRACTICES  L T P C
3 0 0 3

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

80
UNIT I  SYSTEM SECURITY
Model of network security – Security attacks, services and mechanisms – OSI security architecture

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
COURSE OBJECTIVES:

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

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

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

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

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

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

TOTAL: 45 PERIODS

82
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

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

UNIT I
UX LIFECYCLE TEMPLATE

UNIT II
CONTEXTUAL INQUIRY
Constructing your work activity affinity diagram (WAAD). Abridged contextual analysis process. History of affinity diagrams.

UNIT III  DESIGN THINKING, IDEATION, AND SKETCHING  9

UNIT IV  UX GOALS, METRICS, AND TARGETS  8

UNIT V  ANALYSING USER EXPERIENCE  10

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
3. UX Fundamentals for Non-UX Professionals: User Experience Principles for Managers,
Writers, Designers, and Developers, Edward Stull. Apress, 2018

4. Lean UX: Designing Great Products with Agile Teams, Gothelf, Jeff, Seiden, and Josh. O'Reilly Media, 2016

5. Designing UX: Prototyping: Because Modern Design is Never Static, Ben Coleman, and Dan Goodwin. SitePoint, 2017

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

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

UNIT I INTRODUCTION 9

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

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

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

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

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

UNIT III MULTIMEDIA TOOLS 9
Suggested Activities:
1. Flipped classroom on multimedia tools.
2. External learning – Comparison of various authoring tools.

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

UNIT IV  MULTIMEDIA SYSTEMS  9

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:
## CX4016  ENVIRONMENTAL SUSTAINABILITY

<table>
<thead>
<tr>
<th>Unit</th>
<th>Course Content</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIT I</td>
<td>INTRODUCTION</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Valuing the Environment: Concepts, Valuing the Environment: Methods, Property Rights, Externalities, and Environmental Problems</td>
<td></td>
</tr>
<tr>
<td>UNIT II</td>
<td>CONCEPT OF SUSTAINABILITY</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Sustainable Development: Defining the Concept, the Population Problem, Natural Resource Economics: An Overview, Energy, Water, Agriculture</td>
<td></td>
</tr>
<tr>
<td>UNIT III</td>
<td>SIGNIFICANCE OF BIODIVERSITY</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Biodiversity, Forest Habitat, Commercially Valuable Species, Stationary - Source Local Air Pollution, Acid Rain and Atmospheric Modification, Transportation</td>
<td></td>
</tr>
<tr>
<td>UNIT IV</td>
<td>POLLUTION IMPACTS</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Water Pollution, Solid Waste and Recycling, Toxic Substances and Hazardous Wastes, Global Warming</td>
<td></td>
</tr>
<tr>
<td>UNIT V</td>
<td>ENVIRONMENTAL ECONOMICS</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Development, Poverty, and the Environment, Visions of the Future, Environmental economics and policy by Tom Tielenberg, Environmental Economics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>TOTAL : 45 PERIODS</td>
<td></td>
</tr>
</tbody>
</table>

## REFERENCES

## TX4092  TEXTILE REINFORCED COMPOSITES

<table>
<thead>
<tr>
<th>Unit</th>
<th>Course Content</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIT I</td>
<td>REINFORCEMENTS</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Introduction – composites –classification and application; reinforcements- fibres and its properties; preparation of reinforced materials and quality evaluation; preforms for various composites</td>
<td></td>
</tr>
<tr>
<td>UNIT II</td>
<td>MATRICES</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Preparation, chemistry, properties and applications of thermoplastic and thermoset resins; mechanism of interaction of matrices and reinforcements; optimization of matrices</td>
<td></td>
</tr>
<tr>
<td>UNIT III</td>
<td>COMPOSITE MANUFACTURING</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Classification; methods of composites manufacturing for both thermoplastics and thermosets-Hand layup, Filament Winding, Resin transfer moulding, prepregs and autoclave moulding, pultrusion, vacuum impregnation methods, compression moulding; post processing of</td>
<td></td>
</tr>
</tbody>
</table>
composites and composite design requirements

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

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

REFERENCES

NT4002 NANOCOMPOSITE MATERIALS L T P C 3 0 0 3

UNIT I BASICS OF NANOCOMPOSITES

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

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

UNIT IV NANOCOMPOSITE FROM BIOMATERIALS
Natural nanocomposite systems - spider silk, bones, shells; organic-inorganic nanocomposite formation through self-assembly. Biomimetic synthesis of nanocomposites material; Use of synthetic nanocomposites for bone, teeth replacement.
UNIT V  NANOCOMPOSITE TECHNOLOGY  9

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

UNIT III  BIOSAFETY  9

89
UNIT IV  GENETICALLY MODIFIED ORGANISMS

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

UNIT V  ENTREPRENEURSHIP DEVELOPMENT


REFERENCES


